Basilisk is well worth reading.

THE

BRITISH CYCLOPÆDIA

OF

NATURAL HISTORY.

THE BRITISH CYCLOPÆDIA OF NATURAL HISTORY:

COMBINING

A SCIENTIFIC CLASSIFICATION OF ANIMALS, PLANTS, AND MINERALS;

WITH

A POPULAR VIEW OF THEIR HABITS, ECONOMY, AND STRUCTURE.

BY AUTHORS EMINENT IN THEIR PARTICULAR DEPARTMENT.

ARRANGED AND EDITED

BY CHARLES F. PARTINGTON,

PROFESSOR OF MECHANICAL PHILOSOPHY, AUTHOR OF VARIOUS WORKS ON NATURAL AND EXPERIMENTAL PHILOSOPHY, &c. &c.

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INTRODUCTION.

NATURE is the general name for all that exists, so as to be perceptible by the human senses, without being planned by human contrivance, or executed by human labour; and in this, its general meaning, NATURE stands opposed to ART. But the line of distinction between the two is by no means precise, inasmuch as all the materials of art are natural substances, and all the processes of art are applications of natural principles.

Hence, although practice may render the hand more dexterous in execution, yet before art can be in the least extended—before one addition can be made to the accommodation and comfort of mankind—we must go to nature for the materials, and to a knowledge of nature for the method of using them.

Nature, then, is all to us both for knowing and for doing—our life, our means of living, our enjoyment; and when our knowledge of it becomes so extended as to enable us to see that it is *one whole*, the countless parts of which work together with incalculably more nicety than any machine which the most skilful of us can put together, that these parts have within themselves a power of repair and reproduction which we are unable to imitate even in the slightest degree—when we carry our contemplation thus far (and if we think for ourselves, the distance is not a long one) the conclusion is irresistibly forced upon us,—that subjects so many, so varied, so beautiful, so exquisite in their structures, so perfect in their adaptations—principles so simple yet so powerful, operating at all distances, efficient alike upon the atom and upon the mass,—now determining the orbits of comets, and the career of planets, through space to which we can assign no bounds; and again, bringing back the green mould on the bark of the tree, or peopling the waters with myriads of living creatures,—that this majestic structure must have had a Maker; and that those laws which congregated worlds obey as easily as the thistle-down yields to the wing of the tempest, must have emanated from One, compared with whom, human strength, and human wisdom, nay, all that is material, must be as nothing.

It is this vast extension, this endless application of natural history, and its tendency to promote a more perfect knowledge of the works of creation, which raises it so high in the scale of human inquiry and pursuit, and which renders every attempt to impart it in more accessible, more easy, or more persuasive forms, one of the most praiseworthy services that can be rendered.

No doubt the lessons of nature abound everywhere. They come to us in the beams of the sun, producing days and seasons, clothing the earth with plants, peopling it with animals, and making it gay with flowers, tuneful with songs, lovely to every sense, and abundant to every wish. Those beams command the winds of heaven, sending them to one place with drought, to another with rain,—making the calm to glitter, the breeze to rustle, the gale to sweep,—gleaming the lightning here, and volleying the thunder there,—and producing, by the variety of their own action and that of the surfaces and substances on which they act, all those phenomena of the weather and what the weather brings, about which we speak so much and know so little. Air and sea too, in their own properties are volumes teeming with instruction, if we could read them; and we soon could if we would. Of the solid matters which compose the earth, of its plants and its animals, whether on the land or in the sea, it is unnecessary to speak, because man has no wealth but from them, and no means of acquiring it but by the knowledge of their properties. It is indeed the very extent of nature which deters us from the study of it; and when we do attempt that study, after knowing by report how extended it is, we do not find the same assistance as in those secondary applications of it which are more immediately accordant with our daily pursuits, or more immediately within the grasp of common minds.

This is not to be wondered at: Nature being the source of all the sciences, and the most successful observers having extended only a little way in their knowledge of it, it is utterly impossible that any man can come so prepared as to understand it all, or even live so long as to acquire a thorough knowledge of any one division. But still there are many labourers in the field, their numbers are increasing every day, and it is one in which all may labour without slackening their hand in any other pursuit; though it is not one the whole of the acquired knowledge of which can be generalised into a single science.

The principles, and the practical observation or knowledge of facts, must be taken apart from each other; the former constituting what may be generally termed The Physical Sciences, which more immediately connect the observed facts with, and render them useful in, the arts; and the latter constituting the science of Natural History, or the appearances of nature in all its departments, as they present themselves to the senses.

But Natural History must not be confounded with *history*, in the common application of the term, as recording the succession of actions in time merely; for it includes, also, the knowledge of all natural subjects *as they exist in space*, and not only in their single characters, but in their relations to each other, to the proximate subjects among which they are found, and to nature generally in its co-existence, and in as far as is possible in its succession.

These considerations will readily be admitted, when it is borne in mind that nature furnishes us with powers and instruments, as well as with materials; and that, though it is chiefly as materials that we ultimately apply nature to use, the abundance and quality of these depend upon the efficiency with which we can make the powers of nature work for us; and that of course depends upon our knowledge of those powers. The truth of this stands in need of no argument or illustration; we have only to direct our attention to the garden, the field, the meadow, and the forest, and consider where would be our food and our clothing, and even the possibility of our existence, if the natural powers which are daily and hourly at work for us there were to cease for one season or one month.

PLAN OF THE WORK.

Regarding Natural History as we have attempted to define it, without even implying disparagement to any of the existing publications, it may be said, that a work which shall place the whole subject before ordinary readers, in an accessible, easy, and ample manner, brought down to the present advanced state of science in all its departments, and yet freed from the technicalities of science, which are perplexing to ordinary readers, is still a desideratum. To supply that desideratum is the purpose of the present work; and that purpose is sought to be accomplished, by avoiding the granderror into which the projectors of most works of a similar nature have fallen, that of making a collection of detached articles, not only without connexion in themselves, but scattered through many volumes, filled with other matters, which destroy the usefulness of each other by the confusion; and, by rendering frequent repetition unavoidable, greatly reduce the value of the work as a book of reference.

The plan which has been adopted for avoiding these faults, and ensuring the opposite advantages, has been to combine the two principles of a complete and connected SYSTEM OF NATURAL HISTORY, with an ALPHABETICAL DICTIONARY; and it is confidently hoped that the success and the advantages of this compound plan will be equally apparent. The complete system will ensure the same connexion, and the same freedom from repetition, as if the work were performed by one author and published at one time; while the alphabetical arrangement will enable the reader at once to turn to any single point upon which he may wish to be informed.

The systematic arrangement of the productions of nature, in the divisions and subdivisions into which they have been distributed by the best authors, furnish at once the plan, which has only to be properly executed in alphabetical order; and then, the purpose is attained, and the work rendered equally available and equally useful for systematic study and for consultation upon any single point that may be required. A short account of the manner in which this is to be accomplished will serve at once as a key to the work and an introduction to the study of Natural History.

One principle will run through the whole: that of giving under each article all that properly belongs to it, giving that clearly, and as fully as appears to be consistent with the interest of the reader and the extent of the work, but giving no more.

In following up this plan, the various classes into which animals, plants, and minerals have been divided by naturalists will be given in their alphabetical order, with the characters on which the class is formed; to this will be appended the orders into which the class is divided, and which will be found also in the order of the alphabet. From these again the reader will be referred to the family, and from the family to the minor groups or genera.

It is evident that reference can be made from particular articles to general ones as readily as the other way; and that, therefore, not a single line of repetition will be necessary in any of the articles, because each article will explain all that relates to its own subject; and if the reader wishes to turn to any thing more general, he will have only to look at the commencement of the article, to see from what articles that one subdivides or branches, and he can easily turn to these.

The same method will be followed through all the steps from the class down to the species, in every instance in which it can further the purposes of information to descend so far; and where that is unnecessary, the more important species will be found described under the genus or other final group, which appears to favour the grand object of furnishing the most abundant and accurate information, in the most accessible form and in the smallest compass.

In the references, the common English name (when there is one), and the systematic name will be given together; and where it suits equally well for other purposes, the alphabetical arrangement will follow the English names. This will prevent waste of space, make the work at once adapted for popular reading, without the labour of acquiring learned names, and occasion no difficulty to those who follow the systematic arrangement from the more general articles to the more particular, because if they do not find the next stage of the description under the one of the two names which are in juxta-position, they may make sure of finding it under the other.

NATURE is usually considered as divided into three KINGDOMS, of which short explanations are given in the following sections.

THE ANIMAL KINGDOM.

These words are expressive of one of the three great divisions of material substances; namely, all those that are possessed of *animal life,* as distinguished from plants, which have *vegetable life,* and from minerals, which are understood to have no life of any kind. In what we are accustomed to call the more perfect instances of them, the distinguishing characters of all the three are so clear and explicit, that nobody has the least hesitation or difficulty in discriminating them; and thus they neither need nor admit of explanation. They belong to that department of knowledge in which words can add nothing to the information derived immediately from the senses; and, therefore, in proportion as attempted definition becomes more elaborate, it also becomes more inapplicable. When, however, the characters have a certain degree of obscurity, and one part of the subject belongs, or appears to belong, more to one division, and another part more to another division, it then becomes rather puzzling to decide, and popular judgment assigns the subject to that division of which it has the external characteristics most conspicuously. With the products of the land there is little difficulty; for though the forms of some plants, or parts of plants, have a slight resemblance in shape, and occasionally in colour, to animals—as, for instance, the flowers of some species of *orchis* to insects, and the fruit of some cucumbers to snakes, yet in these as in all other cases of land plants, there are always accompanying parts or circumstances, which prevent the possibility of mistake; and the observer can admire the resemblance, just as he would admire a picture, without any danger of confounding the identity. Farther, as the food of animals does not come regularly in the air, all land animals are, to some extent or other, locomotive, and none of them are rooted. We know less of the food of plants than of that of animals; but it is probable that all plants feed in part upon air, or, which amounts to the same, upon air-borne substances; and, therefore, though all plants are not rooted in the earth, none of them are locomotive. The common sensitive plant, and the various other plants, the leaves and other parts of which move when touched, do not indicate the least approach to the animal character. Growth from the end, drooping in the heat, erection of the leaves during a shower, are motions common to most plants; and the plants alluded to are merely instances of some of the more singular modifications of the common vegetable motion.

In the waters it is different; and though, even there, there is no danger that a plant shall be mistaken for an animal, or that the whole of an animal (when known) shall be mistaken for a plant, yet there are cases, in which, from our ignorance of the whole, we are in some danger of mistaking part of an animal for a vegetable, or even for a mineral. The water, by its natural currents, and also by the smaller currents, which many of its inhabitants are capable of producing, brings their food to many of those inhabitants, just as the air does to plants upon land. And of the species which are fed in this way, which are often very minute, there are many that are elevated upon stems or pedicles, and these are so plant-like in their forms, that they have sometimes been regarded as plants; and writers on vegetables have claimed the sponges, corals, and corallines, as members of the vegetable kingdom. On the other hand, the supports of some of these aquatic animals take so much the form, and acquire so much the consistency, of rocks, (as in the small animals which form coral reefs with such wonderful rapidity in some seas,) that they have sometimes been considered as minerals. But a very little observation enables us to make the distinction, even in those cases in which it appears to be most obscure. The hard parts of animals generally burn into lime (though in some of the obscurer aquatic ones there is silex), or we can detect lime in them by chemical tests; and in the progress of burning, they all, more or less, give out an ammoniacal smell,—that smell which is so powerfully given out in burning feathers; and they give out that smell the more strongly, the less proportion the lime which remains bears to the whole substance. Only a few aquatic plants contain lime, while several of them contain silex, but that is in the bark, rather than the inner parts; as, in those animals which contain it, it is in the case rather than the animal itself. Burn a bit of sponge or of coralline, and then a bit of the sea-weed or other vegetable which resembles it the most, and the smell will at once point out which is the animal substance, and which the vegetable.

It is not by any essential difference in the matter of which they are composed, that we are enabled to ascertain to which of the three kingdoms of nature any substance belongs, for all matter, considered in its mechanical and chemical properties only, is mineral, even when it forms part of the organisation or structure of a vegetable or of an animal. The kingdom must be determined from the combination and arrangement of the parts. If these are everywhere the same, and the whole dependent upon those general laws of mechanics and chemistry,—which hold in like manner, though not to like extent, between particle and particle, as between mass and mass, so that the larger mass may be considered merely as a multiple of the smaller,—then the substance is a mineral one; and it is a solid, a liquid, or an air, or *gas*, according to the state, which state depends upon the great modifying principle, or principle of *action*, in matter, which we know only in its effects, and which we call magnetism, electricity, light, heat, vegetable life, animal life, according as it appears in different modifications, rather than from any knowledge that we have of it in itself, either as essentially the same, or essentially different, in those several modifications, and the almost endless diversities in which they appear in nature, or in the operations of art.

When the parts of a subject, whether formed of the same combination of matter, or of different ones, have a local distribution, and a difference of function, so that the whole subject is not a multiple of any one of them, but the aggregate of the whole, and has its properties as a compound being, depending upon the form and arrangement of those parts, rather than upon their mere chemical or mechanical properties as matter, then we call it an *organic* or *organised* being, the production, not of the common principles of chemical and mechanical action, but of *life:* which life, in fact, acts in opposition to the common laws of mechanics and chemistry; and when from any cause it can so act no longer, the organic being *dies*, ceases to display any of the functions of organic life, and becomes an *organic remain;* and though, as such, some parts of it, as for instance, the bones and shells are found, not merely in accumulations of mud and rubbish in a loose state but after they have been consolidated into rocks, there are always some parts of the organic structure which yield to the common laws of matter so soon after the life is extinct that we can have no interval of time between them. The hard timber of the oak or the cypress may remain for centuries; but the sapwood, and especially the living body, intermediate between the bark and the wood, speedily perishes. The bones take some time to moulder in the earth, and they remain even longer bleaching upon its surface, especially if the climate is uniformly cold; but the most anxious watchfulness can hardly determine whether the breath in the nostril, or the beam of life in the eye, is the first to vanish.

The distinctions of the three kingdoms of nature are thus not absolute and essential, but relative. The matter which is now in one of them may have formerly been in another; and may be in another again. But the relative difference is generally obvious enough; and we can not only, in most instances, easily draw the line between what is living and what is not, but in dead matter we can distinguish the organic remain from that which either never has been organised, or has so far yielded to the laws of inorganic matter as to have had all its organic characters; and of organic substances, whether living or dead, we can generally distinguish between the animal and the vegetable.

These preliminary considerations are necessary in order to have a clear understanding of the extent and limits of the *Animal Kingdom,* but they do not fall within those limits; and will not therefore have to be reverted to in the sequel of this article. The animal kingdom comprises animals only in their living state; and, as such, the knowledge of it is ZOOLOGY, or "The Science of Life." Zoology admits of ready and obvious division into three parts. First, the structure of the organs of animals,—the science of ANIMAL ANATOMY, or, as the general science was first appropriated to the structure of men, COMPARATIVE ANATOMY. Secondly, the uses, functions, and actions of the organs in their combination, with the differences of form and habit thence arising, and also the relations of the several animals to each other and to the rest of the material creation, the knowledge of which constitutes the science of ANIMAL PHYSIOLOGY. Thirdly, the external appearances of animals—their habits, general economy, haunts, numbers, and distribution over the earth or in the waters. This is the portion of the general knowledge of animals, which is open and inviting to the knowledge of all mankind, and which, though it cannot be intimately and thoroughly understood without a knowledge of the other branches, is yet so extensive and so inviting, that there are few who do not more or less attend to and understand it. There is no name except the general one of ZOOLOGY which properly applies to the whole of it; for NATURAL HISTORY, as being equally applicable to all nature, is less precise. It is subdivided into various sciences according to the forms, characters, and habits of the different animals; and it is the arrangement of those branches of the description of animals, so as to accord as accurately as possible with the differences and agreements that are actually to be found in nature, which constitutes the value and advantage of a system of *animated nature,* or a statistical table of "the *animal kingdom,*" by means of which the various classes or subdivisions may be more easily known and more clearly understood, in themselves singly, and in their relations to each other and to the whole. There are, indeed, two other divisions of the science of animals, which are highly interesting; but which perhaps require to be treated separately,—DOMESTICATION OF ANIMALS, AND PROGRESSIVE ZOOLOGY. The first of these is a branch of popular and practical knowledge, and probably the most useful in the whole range of zoological science. The other is of a more speculative character; and our information on it is exceedingly vague and imperfect, especially upon the very points upon which it would be most desirable to be informed. It relates to the changes that have, in the lapse of years, taken place in the numbers, the localities, and the species of animals; which races of them have become extinct, and when, and by what means; and whether any new ones have come in their place, and if any, which, and by what means. To assist us in the first branch of that inquiry, the data are obscure and few. The remains of the lost animals which appear to have inhabited the land, are deep in the earth, and those of some of the former tenants of the waters (if analogy of structure is to be any guide, and other than that we have none) are often found on the mountains at miles above the present level of the sea. On the other branch of the subject, we are without any guide, and all that we can say is, that, as far as our observation goes, there is not in the productive powers of existing animals any means of producing a new species; and we know of no source whence any animal can be produced, but by parent animals of the same species. The species is, indeed, somewhat plastic under the hand of natural circumstances, or the resources of art; and may be broken into varieties differing much from each other in external appearance and in disposition; but still there appear to be specific bounds which no art, and not even nature itself, can pass.

ARRANGEMENT OF ANIMALS.

No arrangement of animals can be perfect; first, because we do not know that we are acquainted with all the species; secondly, because there are many species of which we know very little; and thirdly, because of those which we know best, the greater part are known as more or less domesticated; and we are consequently unable to separate the natural parts of their characters from the artificial. The system of the late Baron Cuvier possesses simplicity as well as some other advantages, and therefore, in brief outline, we shall nearly follow it, though in different language, and with such alterations as may seem more suited for ordinary readers. The fundamental principle of that system may be said to be the greater or less development of the principle of life, as indicated by the brain or central part of the cerebral or nervous mass being both more produced and more localised, or, if the expression may be allowed, more or less concentrated; and in proportion as life is thus more developed, and, according to our ordinary mode of expression, more complex, or has a higher degree of organisation, it is also more easily deranged by mechanical injuries, and parts that are mutilated or destroyed, are not so easily restored or replaced. A wound in the human body always leaves a scar, unless where healed by what is called "the first intention," or without inflaming or granulating: and though so healed, it leaves a raphe or seam if it be large. When a nail is torn off the human finger, it is not often replaced by one equally perfect; and if even the tip of a finger is cut off, it does not grow again. The parts, within certain limits, have the power of preservation and repair; but the production of that which we call the more perfect animal appears to be the effect of one united and concentrated energy, which cannot be made to act again in the reproduction of a single organ. As we descend in the scale, and the energy of life is less concentrated, the power of reproduction increases. The leg of a frog, or the claw of a crab, will grow again; and when we descend still lower, to some of the small formless animals which inhabit the water, we find that almost any part can be reproduced; and that the species may be multiplied by mechanical division, as the segments grow to perfect animals. There is not, however, any gradual chain traceable from the one to the other; all species are distinct, and we can only form larger groups by means of some general characters, and leave the particular characters to the smaller subdivisions.

The most important and general, as well as the most obvious distinction, is that of *Vertebrated* and *Invertebrated* animals; or, animals which have spinal columns or back-bones, and animals which have not. To avoid repetition, and insure brevity, we shall take these in their order, without contrasting the one with the other.

VERTEBRATED ANIMALS.

These have the central mass of the nervous system inclosed in a case of bone, commencing anteriorly in the skull, and continued through the spinal column, which consists of a greater or smaller number of pieces or vertebræ, (but always of the same number in the same species,) variously articulated, or jointed together, according to the strain that they have to bear, and the motions they have to perform; but always well secured against dislocation, and so formed that the nervous mass which passes through them can sustain no injury in their ordinary and natural motions. This column may be considered as the centre or basis of the organisation to which all the other bones which support the softer parts are articulated. To the anterior extremity of the column are united the bones of the face and mouth, the latter consisting of two jaws, placed the one above the other, and having their principal motion in the elevation and depression of the under jaw, and the jaws variously furnished with teeth according to the habits of the species and the nature of their food. The other extremities, or limbs, never exceed four, are sometimes only two, and sometimes wholly wanting. They are more or less intimately articulated to the vertebral column, according as they support that column; and their forms and relative developments, like those of all the other parts, depend on the habits of the animal.

The muscles, or organs of motion, in those animals, are, with the exception of some that answer particular purposes in the economy, and are mostly styled *involuntary,* inserted in the bones, one on each side of a joint, and they pull the *distal* bone, or bone farthest from the spine, into a new position by their contraction.

The skin, or external covering, is flexible, and consists of an epidermis or cuticle, a mucous tissue, and a corium or true skin. The appendages to it are fur, hair, feathers, or scales; and while the animal is in health it is capable of resisting both air and water at the ordinary temperatures.

The brain, or cerebral mass, with its continuation in the spinal column, and the prolongation in various nerves or chords, forms the system of sensation. The other systems are the nourishing, the circulating, the respiratory, and the productive.

The nourishing system consists of the mouth, the stomach, and the intestinal canal, by which the food is received and assimilated so as to render it fit for being mixed with the blood.

The circulating system consists of a heart, arteries, and veins. The heart, even for one system, consists of two cavities, a ventricle, or more muscular one, which propels the blood through the arteries, and an auricle, or weaker one, which receives it on its return through the veins. But in most animals of this division there are two systems, one of them pulmonic, or receiving the blood from the body, and sending it to the lungs or other organisation that answers a similar purpose and the other systematic, receiving the blood from the lungs, and circulating it over the body. By the systematic arteries the waste of the body is supplied; and by the returning blood through the systematic veins, the matter which has ceased to be fit for the purposes of life is taken up. The blood, thus loaded with the waste of the system, is sent to the lungs, or other respiratory organs, where the refuse, which appears to consist principally of charcoal, unites with the oxygen of the air, in the case of lungs, or with oxygen separated from water in the case of gills; and these combined are given out in the state of carbonic acid gas, and in very nearly the same volume as the oxygen required.

The respiratory system is for the supply of the oxygen, to accomplish which air is taken into the cells of the lungs, or water made to pass between the fibres of the gills, the blood being in the mean time exposed to it, not naked, but in minute vessels, of which the coats are exceeding delicate. The details of these systems, further than they are connected with the external appearances and characters of animals, belong to physiology rather than to this branch of the science.

In the productive system the males and females are, in most instances, different individuals, and they are viviparous, oviparous, or ovoviviparous. The first, which bring forth their young alive, are either *placental* or *marsupial,* the former bringing forward their young in an internal uterus; the latter bringing them forward in a marsupium, or pouch on the abdomen, which also serves as a bag for carrying them in while they are very young. The oviparous produce eggs, which are hatched externally, with or without the heat of the parent, according to the species; and the ovoviviparous produce eggs which are hatched internally, and the young brought forth alive. The last of these bear some slight resemblance to the marsupial animals; and it is said that the young, in the very early state, sometimes take refuge in the envelope in which they were hatched; but this fact is not very clearly ascertained.

In all cases, however, the young is, from the very beginning, that is, from the first rudimental state in which it can be traced, a being distinct and separate from the mother;

and whether it is in the womb, the marsupium, or the egg, its circulation, as soon as it has one, as an entire system, is its own, and not part of that of the mother. The umbilical cord is a substitute for feeding and breathing only; and the pulse of the fœtus is not connected with, and does not beat at the same rate with that of the mother, and either may survive the other, though the young in the early stages can do so only for a very short time. Here, again, the details, interesting as they are, properly belong to physiology.

The gradation of vertebrated animals may be considered as ranging from man to the fishes; and in the range there are four distinct classes very well defined, both by their structure and their habits. Beasts, Birds, Reptiles, and Fishes, are the common English names of these four classes. The first of these is neither very descriptive nor very precise in its meaning, as it is originally co-extensive with animal, or even with being; and therefore it is advisable to substitute for it the term Mammalia, which is strictly descriptive of the most peculiar and distinguishing character of the class.

INVERTEBRATED OR SPINELESS ANIMALS.

Though these animals are all much smaller in size, and possess the principle of life in what we are accustomed to call an inferior degree, their inferiority is of course merely relative; because the structures of all animals, when considered with reference to the functions which they perform, are equally perfect. But still, there is a very marked difference between the two grand divisions of animals; and, if the terms can be admitted, it may be said, that while vertebrated animals are organised upon the brain and its spinal prolongation, as a basis, the invertebrated animals are organised upon the stomach, or the alimentary system. Not that it by any means follows that these animals feed either more frequently or more abundantly than the vertebrated races; for many of them, in certain stages of their being, do not eat at all, and in several, the functions of life, and feeding among the others, can be suspended for years—in all probability for ages—without death ensuing. The resemblance which these suspensions of the functions of life in the invertebrated animals bears to hybernation in the other classes has not been traced, and is, perhaps, not traceable; but it may be stated as a general fact, though one to which there are no doubt exceptions, that they obey the common physical laws of matter much more readily than the vertebrated animals, being strongly influenced, not only by climate and season generally, but by the slightest changes of the weather, and even by the times of the day.

It accords with general principles, that this greater obedience in the animal to the common laws of matter should be the result of an inferior development of the principles of animalisation; for, in all the races with which we are most conversant, we invariably find that the more sluggish life naturally is, it is the less easily extinguished. It must not, however, be understood that this inferred or presumed inferiority in the invertebrated animals is accompanied by a diminished intensity of any particular function. Indeed, it is rather the reverse; for the very same principle which enables the animal to yield more readily to external circumstances must also enable the whole of its energy, so to speak, to go more readily and completely to the performing of any one function. Accordingly, we find muscular action and the endurance of mechanical injury so great in some invertebrated animals, that we can hardly institute any comparison between them and the vertebrated ones. Comparing the size, the grass upon the most finely mown lawn is apparently more formidable to many insects than the closest jungle or forest would be to us. But the insect makes its way easily and without fatigue; and not only that, but it pushes aside substances as large in comparison with its own bulk as if a man were to push the carts and waggons, nay almost even the houses, out of his way as he walks the streets. If the spring of the lion, or the bound of the antelope, were to bear the same proportion to the size of those animals as that of the common flea or the lobster, the last of which has to leap against the reaction of water, it would be almost from jungle to jungle, or from mountain to mountain; and if the strongest-shelled tortoise were to fall from a height proportional to that from which many of the invertebrated animals can fall with perfect impunity, it would be dashed to pieces.

From all that we can observe, we have reason to conclude that the nervous or sensatory system admits of the highest degree of animal organisation, the one which is the farthest removed from the common properties of dead matter; and in proportion as that system is more developed and predominant, the functions of the animal become more varied, but individually less capable of effort, and altogether less capable of endurance. A very slight wound causes death in the mammalia and birds; and though the reptiles and fishes can recover from severe lacerations, they are all suceptible of being wounded to death; but when we come to what may be considered the inferior tribes of the invertebrated animals, where there are few functions, few organs, and nothing which can be positively pronounced to be a distinct nervous system—the entire animal being little else than a skin which can feel—we find that no cutting, and hardly even pounding in a mortar, can put the creature wholly to death. Still we do not know enough of the functions of those animals, or of the developments of the different systems in the different races of animals, to enable us to arrive at any certain conclusions with regard to the relations which the intensities of actions in those several systems have to each other, or to the power of endurance or of action in the animal generally, or the other systems which make up its organisation.

Hence it is necessary to observe great caution in assigning the energy of one part of the organisation to another part, or of pronouncing any one of the systems of which the organisation is made up as being the sole, or even the chief, seat of animal life. Even from ourselves, where, as we have feeling added to observation, our knowledge should be most perfect, we can conclude nothing without a stretch of theory which does violence to the truth. The circulating, the nervous, and the alimentary systems have at times been each regarded as the seat of animal life in man, (not as the locality of the mind, for that mind can have physical locality, while from its very nature it can have no physical extension, involves a contradiction in terms,) but of our animal life without any reference whatever to the mind. In fact, those principal systems seem to be all pretty equally the seats of life, as there are peculiar injuries which, if done to any of the three, will extinguish it with equal rapidity.

Indeed, the safest conclusion is that the life is in the organisation rather than in the organs; and as we cannot subject that to experiment, we can safely carry our theories no farther than the facts which actually come under our observation. Of this much we are certain, both from what has been mentioned of the invertebrated animals, and from what we observe in the vertebrated ones, that the perfection of the nervous system is not in proportion to the motive one, and, perhaps, sometimes not even to perception itself, in at least some of its forms, whatever it may be in others. The nervous system in the eagle and the vulture is much less perfect than in the mammalia; and yet the vision of the one, and the means, whatever they may be, by which the other finds out its food at very long distances, are far more acute than any similar capacity in the more perfect class. The return of bees to their hives and other resting places, and countless other habits of invertebrated animals, which cannot depend upon any thing at all analogous to the operation of our senses, are well calculated to teach us caution in coming to those conclusions, respecting the animals that differ greatly from ourselves in their organisation, to which we are too apt to be betrayed when we begin the study of zoology.

The fact of being invertebrated serves to separate this division of the animal kingdom from the former, but as it is a negative, it cannot be made the foundation of a positive definition; and the animals differ so much from each other, that it is not easy to write any thing general respecting them. If the nervous system be taken as the foundation, there is tolerably distinct subdivision; but it is an internal one, often not very easily ascertained, and still more generally hidden from popular observations, so that it is of little use to common readers.

The first of these subdivisions has what may be considered, perhaps, as the principal brain in the form of a sort of collar surrounding the gullet. From this collar nervous filaments proceed, which thicken into knots or ganglions in the course of their length, and the animals which have them have thence been denoted Gangliata, or ganglionic animals; but the term does not carry much information. Of these ganglioned animals there is another division, which, if the structure of the nervous system is to be taken as the foundation of arrangement, is of considerable importance; namely, that of those which have something analogous to a spinal cord, though not supported by a spinal column, unless we are to consider the external covering which invests the whole body as having that character, and those which have the nervous filaments diffused from the originating collar in such form that no one of them predominates very much over the rest. The first of these have the principal nervous elongation in the form of a cord, extending longitudinally backwards, and enlarged into a greater or smaller number of knots or ganglions; and as the body is often formed into joints or segments, having some slight resemblance to rings, these have been called Annelides, or ringed animals. There are so many diversities of appearance, habit, and the structures of the other systems, that no very precise or satisfactory information can be grounded upon these characters. There are, however, some external characters accompanying this knotted nervous cord. The animals have a head, though, in the common meaning of the word, a brainless one; and they have detached or articulated feet, or some sort of substitutes for them. They have also, in some instances, internal cartilaginous substitutes for bones; their external hard coverings, when they have them, are intermediate in their composition between bones and shells; and they have at least some of the organs of sensation belonging to the vertebrated animals, or at least bearing some analogy to them. They have also this farther in common with the vertebrated animals, that if their bodies are supposed to be divided vertically by a mesial plane passing from the anterior to the posterior extremity, the external parts are symmetrical, that is, the one half corresponds with the other, only the one is turned to the right, and the other to the left. Those animals are, therefore, to be considered as making nearer approximations to the vertebrated animals in some of their characters, both external and internal, than any others of the invertebrated ones.

The second subdivision of gangliated animals have no resemblance to the vertebrated animals in their structure; and they vary so much from each other, that no very precise general account of them can be given. They are termed mollusca, or soft-bodied animals, from the circumstance of none of them having any internal bones, though many of them have shells which entirely cover them, and others have portions of shell, more or less produced, concealed under the skin or in its folds or duplicatures.

The second principal division of invertebrated animals have been called Radiata, or rayed animals; because many of them, in some part of their structure at least, have a radiated form something resembling the rays of a star. That does not, however, so well point out the nature of the nervous system as the epithet *gangliata,* in the former division; because in many of them it is difficult to trace the nervous ramifications to any definite centre.

THE VEGETABLE KINGDOM.

Vegetables, like animals, do not admit of general definition. The name signifies "that which grows;" but though growth is common to all vegetables, it is also common to all animals; and there are some minerals that have a sort of growth. Diamonds, for instance, are tolerably well ascertained to grow in some soils, and rock crystals on some rocks. The growth in each of the three kingdoms of nature is, however, a different operation, acting upon different principles, and producing different results; and, for that reason, growth can form no part of the general definition of any of the kingdoms of nature; though the particular mode of growth is an important character.

A vegetable is, like an animal, a whole, and cannot be divided without mutilation; though the vegetables which admit of being multiplied by dividing the existing ones are much more numerous than the animals that can be so multiplied. The production, growth, and general functions of vegetables, form the subject of VEGETABLE PHYSIOLOGY.

Though some vegetables float in the water, and others hang suspended in the air, yet their general habit is to be rooted in the ground; and no vegetable, whether rooted or not, changes its place, unless removed by some external cause. But this negative quality of the want of locomotion cannot be made part of an exact general definition of vegetables, any more than the active quality of growing; for it is a general property of matter, whether organised or not; and it is also a property of some species of animals.

But though this want of locomotion cannot enter into the definition of vegetables, it is a very important point in natural history, and renders the vegetable tribes far better indications of climates and seasons than the animals are. All animals can, to a certain extent, avoid circumstances and occurrences which are disagreeable to their nature; and though plants can do the same in a very slight degree, more especially in those parts of their organisation which are the most delicate, and, as one would say, the most immediately alive, yet it may in general be said that the vegetable must stand exposed and abide whatever happens. No doubt the power of endurance in them is much greater than it is in animals; and as we have already seen that those animals which have the principle of life the least developed, or have their organisation the most simple, are the most capable of enduring; so we find that vegetables are generally more capable of enduring than animals, and that the more simple the organisation of the vegetable, the more enduring it will be. By endurance is not meant the resistance of external causes and circumstances generally; but rather the obedience to these, or the resistance of destruction, which is really a yielding to the course and operations of nature.

The circumstances now mentioned give a very peculiar interest to the natural history of vegetables. No plant, taken simply in itself, is perhaps so interesting as some animals, as it wants the charms of perceptible activity and affection; but it is in vegetables far more than in animals that we trace the variations of different regions of the earth, and those of the same region in the different seasons of the year. All that we can perceive of the action of the sun, the atmosphere, and atmospheric humidity, upon the inorganic and dead matter of the earth, is illuminating or darkening, heating or cooling, drying or moistening, softening or hardening, or, even in the extreme cases, mechanical division or chemical solution. But vegetables bring into play the principle of growth (at least their own form of it); and the operation of that principle, or, which amounts to the same thing, the operation of climate or season upon it, evolves all those curious forms which every where compose the carpet or clothing of the earth, where its mineral surface is not permanently too cold, too dry, or too shifting, for allowing the principle to act.

The natural history of the vegetable kingdom thus admits more readily and more distinctly of division into three parts than that of the animal kingdom. First, the descriptive history of the species, singly, but in their classification; and that constitutes the science of BOTANY, a word which originally meant *grass*, the grasses being, in the pastoral times, as they are still, the most important vegetables of temperate climates. Secondly, the species of plants which are, generally speaking, best adapted to the different latitudes of the globe, grow most abundantly and readily, and are most characteristic of the scenery there.

This forms what may very properly be termed Vegetable Geography, a very interesting and important department of natural history, but one which has not hitherto been treated of separately to the extent which its importance requires. Thirdly, the seasonal changes which take place in the appearance of plants, and which, as has been remarked, constitute the grand index to the revolving year, and which has not yet received a name as a distinct branch of science.

The two last-mentioned divisions are intimately connected with each other; because plants are influenced by climate only so far as that climate produces season; and if they had the same season, or the same succession of seasons, all climates would be alike.

The general circumstances, whether we call them of a climatal or a seasonal nature, by which plants are influenced, are humidity, heat, and light; wherever these occur to the same extent the action of any one vegetable may be presumed to be the same. It is usual to refer the origin of heat generally to the sun; and though that body is not the source of all heat, and perhaps would not be the source of any without something upon which its beams could act, yet the heat of the sun is that by which vegetables in a state of nature, and even as cultivated, are the most generally influenced. The light of the sun is also the principal and perhaps the only light which has a general influence on vegetable action. No satisfactory experiments have been made to show what might be the effect of artificial lights on vegetables; and though moonlight produces some effects, they appear to tend to ripening rather than to growth. That might be expected, as the light of the moon wants the extreme rays of the solar spectrum, and especially those chemical rays which lie invisibly beyond each extremity of the colours, and which so curiously link together the polarities of atoms, the phenomena of magnetism, galvanism, electricity, vegetable action,—and probably all the phenomena of matter to which the name of action can be applied.

As, however, separate treatises on the various branches of physical science would be out of place in a work expressly devoted to the study and illustration of natural history, the reader will, in every instance, be referred to those articles in the first division of the Cyclopædia, where they are fully examined. The classification of plants as much as possible according to their organisation, will be found in the general article Botany; and the process of vegetation, its nature, and its results, as forming both the component and the constituent parts of plants, will be treated of under the various articles belonging to Vegetable Physiology.

THE MINERAL KINGDOM.

This division, or kingdom, of nature, comprehends all the unorganised parts of the earth: but it may be advantageously subdivided; for, without any reference to their chemical properties, which are fully illustrated in the *First Division* of this work, mineral substances may be viewed in two distinctly different lights,—first, in themselves considered individually; and, secondly, in their relations to each other and to the whole earth, both in its present state and its past history.

Both of these are parts of natural history; but the first of them belongs more to descriptive detail, and the second more to theoretical conjecture. The knowledge of the first is the science of Mineralogy, and that of the second is the science of Geology.

Geology, though of late years it has made rapid progress, is still only in its infancy, so that, though there are many interesting facts, there can be said to be no general system. The general purpose of the science is to examine the whole surface of the earth, and as far below that surface, whether dry land or water, as observation can go; to ascertain the form, nature, and arrangement of the several parts; and to point out, if possible, by what agents and in what manner, they were brought into their present state and situation. Climates and seasons, plants and animals, are all greatly influenced by the substance of which the earth is composed; and therefore, besides that, its more speculative range, there is a great deal of practical usefulness in Geology.

Mineralogy, the other division of the science of the mineral kingdom, admits of being viewed in various lights; the chief of which are, the natural appearances of minerals, and the actions which they are capable of exerting upon each other, or upon other substances. It is the first of these which strictly belongs to natural history; and the general arrangement of it will be found under the article MINERALOGY.

From these short notices of the three kingdoms of nature (which may be considered as a brief summary of the matter of this division of the British Cyclopædia, as the preceding remarks were of its plan) it will be apparent that the science which treats of any one branch becomes the more clear and distinct the more that its characters are peculiarly its own, and the further that they are removed from those general properties and laws of matter which form the subject of the physical sciences. All the parts of Zoology may be rendered intelligible without much reference to the rest of nature; while Botany must either be, in a great measure, confined to description, or reference must be made to the seasons and the weather; and if we do not take into account all the productions and operations of nature, the science of Minerals must be simply descriptive.

CONCLUSION.

THOUGH, as has been stated in the preceding part of this article, there are no external or popular characters by which the three kingdoms of nature can, on their confines (where all their characters are faint and obscure,) be distinguished from each other; yet there are distinctions of a physiological character which are in themselves clear and specific; and to bear this in mind is of the utmost importance to all who study Natural History.

Natural History has a tendency to produce in the mind certain effects which are not produced by the other sciences. These sciences are simple in their principles; and how far soever the investigation of them may be carried, or how valuable soever may be their applications, they address themselves to the understanding only. But there can be small progress in Natural History without bringing the feelings into operation; and when these are excited, the result may be good, or it may be evil. In the mechanical and chemical sciences, we can always see, and generally express, the relation between the cause or power and the consequence or effect; and when we have discovered the relation, or ratio, in one instance, we at once conclude that it will be the same in all similar ones, so that the terms of all are merely multiples, or submultiples, of each other; and the law, when once investigated, has much of the clearness and simplicity of a geometrical proposition, or may be stated numerically and made the subject of arithmetical computation. But it is far different when we come to study nature. Many phenomena, whether locomotive, of growth, or otherwise, take place there, in which we can trace no measurable relation between the apparent cause and the effect. There is, for instance, no relation between the size of seeds and that of the plants which they produce; neither can we tell, from all our experience of the germination of known seeds, whether an unknown one will grow slowly or rapidly. In the animal kingdom, there is still more uncertainty—more to perplex our reasoning and veil itself from our scrutiny. We find, in animated nature, strength where we would be apt to look for weakness, daring where we would predicate timidity, and, in an endless variety of cases, the reverse of what we, reasoning as mechanical philosophers, would infer.

Now, it is an acknowledged law of human nature, that where the understanding is unable to reach the whole of any subject, the feelings invariably take up the remainder; and as that portion by which they are excited is without the guide which accompanies the understanding, there is always some danger that the feelings may lead us into error.

It is impossible to study even the most limited portion of nature without feeling that there is some sort of connexion between that and other parts. The opening of the bud and the song of the bird are, for instance, in some way dependent on the return of the spring; yet we cannot call the spring the *cause* of the one or the other, though it certainly is an element in that cause. The instance adduced is a simple one; and yet the relation is of so complex a nature that we cannot analyse it. When we make the attempt, we are sent far and wide: the sun, the atmosphere, the locality on the earth, the rain which has fallen, surrounding objects, the observed properties of the immediate subject of our inquiry, and that mighty mystery, life, which is felt to be something more than all that we can name as matter, but of which we can know nothing farther than the beings in the production and economy of which it is so indispensable an element. All, whether of plants or of animals, which the season produces, are formed of materials that seem to us to come from the remains of the former season; but besides the materials, there are modes of working, which impart to the species all those characters by means of which they are distinguished from each other, and which preserve those specific characters, amid all the varieties to which they are subject from other causes. In one place, the oak lifts its top high in air, and spreads its boughs so that a multitude may be covered by its shade; and in another place, it is gnarled and stunted. It is still the oak, however, and no soil, situation, or treatment, can change it to another tree. It is the same with all: we find every thing which lives or grows in so far obeying the circumstances under which it is placed; but there is always one part of its character, in which it remains proof against all the viscissitudes of nature, and all the contrivances of art.

That portion we, if we think at all (and who that looks upon even the simplest production of nature can refrain from thinking?) cannot resist tracing backward in time, and inquiring into its origin. Is it of matter? Assuredly not: it is "the workman" by whom matter is moulded into all those forms which we see; and it would not be more absurd to consider the potter identical with the clay out of which he forms his vessels, than it would to confound that which makes a specific plant or animal with the mere matter of which the plant or animal is composed. Is it of the circumstances in which matter is placed? It cannot be; for the sun may warm and illuminate, the rain may distil, and the breeze may play, for ever; but if the germ be not there, there will be no living thing. It appears too that, in all cases, the primary action of the germ is in the dark, and excluded from the atmosphere; yet, even then, it is an independent being, nourished by the parent, no doubt, but forming no part of that parent.

Thus, even the little bud upon the tree, carries us wide over all space, and backward into all time, still leaving something to be added, which the senses cannot discover, and in the investigation of which those instruments which have done so much in the philosophy of mere matter give us no aid. When we point the telescope to the distant, or bring the most minute object under the microscope, we find much that is new, wonderful, and delightful; but the grand discovery is, that we are no nearer the ultimate bourne of knowledge than the dimmest eye in its unassisted glimmerings. It expands to infinitude, it stretches back to eternity; and yet, in all its boundless magnitude and countless duration, it is *one system*. The sun is as much adapted to the planet, and the planet to the sun, as the shell and the kernel of the nut, or any two of the most simple and clearly connected natural productions with which we can meet. Not one single production (no, not one atom) of the whole wonderful structure works alone. Bring the mind to bear on what point soever we may, we are guided toward the whole; so that we dare not deny that the smallest atom in the deepest mine is influenced by the minutest starry speck which the telescope discovers in the depth of heaven's azure.

This is the matter of feeling which Natural History draws forth in a manner different from any other science; and in which truth and error are the very extremes of mental happiness and mental misery. The system has no assignable bounds, yet it is one; the parts are countless, yet they are all in concert; they are ever perishing, yet they are ever renewing; they are ever changing, yet they are still the same. Can we, therefore, believe that a system so vast yet so united, so changeful yet so constant, can be without a Maker and Governor more mighty than it all? Can we by possibility doubt that there is ONE who "sitteth upon the zone" of this mighty structure, and to whom, infinite space is the same as a mere point, and eternal duration as a single moment?

The proofs do not require to be reiterated, or even stated; they are felt irresistibly by all who enter upon the study of nature without prejudice or bias. But the distinction of species, which holds against all circumstances, is an irresistible demonstration that matter is under the government of that which is not material. Were that not the case, we should have those deviations, which may be called circumstantial, taking place as readily in the one direction as in the other; because, if the inherent properties of mere matter did it, there is no reason why a deviation to superiority should not take place as well as one to inferiority. But all the instances of deviation from the specific models with which we meet, are stoppages on the way to the perfect form, and not efforts beyond it. The animal never becomes in any degree a plant, or the plant an animal; neither does one of the more simply organised become one of the more complex, though the complex organisation is often so imperfect in some of its parts as to have a considerable resemblance to the more simple. Thus it appears, that all which the direct interference of the common laws of matter can do for an organic being is to injure or destroy it; and that, though all are flexible to those interferences for a certain length, there is, in all cases, a point at which destruction is the result. But if the organised and living being—the plant or the animal, were produced by the mere properties of that matter of which its body is composed, it is not easy, nay, it is not possible, to see how the same laws that gave it organisation could disorganise it; for that would be making the same principle both itself and its opposite!

There are many instances in which we are not able to trace the law; and in all cases it is a nice and difficult point; but though we cannot always obtain knowledge so complete as to make it a perfectly satisfactory ground of argument, surely we should not better ourselves by grounding argument upon our utter ignorance? It has been already mentioned that the three kingdoms of nature are a little obscure upon their confines; but that very obscurity is sufficient reason why we should draw no conclusion from what we may half discern, half imagine there. Whenever there is light enough, the distinctions are plain; and sound philosophy merely demands, that where we must grope, we ought to grope according to our knowledge, and not in opposition to it. We never find the mould of our gardens changed into roses without the vegetable action of the rose-tree; or the leaves of our trees changed into caterpillars without the action of animal life in the insects; and as little do we find the caterpillars changed into warbling songsters without the specific action of animal life in the birds. But, till one or other of these occur in some one instance, we have no right to presume, as some have unguidedly presumed, that, in those obscure cases where we have little or no knowledge, the very same matter may, according to circumstances, become either animal or vegetable, without the parent and the germ.

THE

BRITISH CYCLOPÆDIA.

NATURAL HISTORY.

AARD-WOLF, *aerd-ouf*, or earth wolf (*proteles cristata.*) A carnivorous animal of Southern Africa, bearing some resemblance both to the hyæna and the fox, but still so different from both, and also from every other known species, as to warrant its being classed as a separate genus. Its size is about the same as that of the fox, but it is shorter and thicker in the body, and the legs are a little longer in proportion. The nose is somewhat produced, pointed, and without hair; the ears moderately long, slender, and nearly naked; the body is covered with woolly

Aard-Wolf.

fur of a yellowish ash colour, brindled with darker brown and black in transverse bands; there is a stiff bristly mane along the whole back from the nape to the tail, which is highest in the middle, and gives the animal a "pig-backed" outline; the tail is covered with hair nearly of the same texture, but not quite so long; and the mane is brindled and the tail slightly marked with rings.

There are four walking toes upon each foot, and a small thumb on each of the fore ones, articulated higher than the others, and not coming into use in walking. The claws are rather long and strong, but they are digging claws rather than prehensile ones. Indeed, though in structure this animal is carnivorous, it appears to be a mild and timid creature, living rather socially with its species, in burrows under ground, and not coming much to the surface during the day, at least at certain seaons. It is a curious feature in the natural history both of Southern Africa and the southern plains of South America, that there should be in them races of animals intermediate between the *insectivora* and *carnivora* properly so called, which dwell and feed under the surface at those times of the year when that surface is little else than an arid waste.

ABDOMEN. This term is generally understood by naturalists as descriptive of a portion of the animal structure somewhat analogous to the third and last great division of the human frame, though, in some cases, a similarity of form and situation has alone occasioned the adoption of that name. So long, however, as we confine the name of abdomen, as above described, to animals of the class Mammalia, it is perfectly correct. As the Mammalia and Birds, in the principles of their formation, require a provision to be made for an extraordinary exercise of bodily activity, and particularly of rapid circulation and respiration, they are furnished with an apparatus capable of powerfully inflating the interior of their lungs; at the same time, the thoracic organs are found insulated from the abdominal viscera, and the cavity of the latter is perfectly circumscribed and well defined. But with reptiles and fishes (still speaking of vertebrated animals), the arrangement of the organ is found to be changed, according to the different conditions of their existence. In the first, one simple cavity encloses the respiratory, circulatory, and digestive organs. If from the vertebrated, we pass to the invertebrated animals, we shall not find in them any cavity to which the name of abdomen can properly apply, as being receptacles formed of the same elements and inclosing the same viscera. With these the organs of circulation, respiration, and digestion, no longer occupy distinct cavities; to neither molluscous animals, worms or annelides, can we properly attach the terms thorax and abdomen, as they are defined in the human anatomy.

In the Arachnidæ the continuation of the thorax is called the abdomen; and no doubt has arisen as to its analogy with the abdomen of insects. It may, however, be observed, that the resemblance only holds good, inasmuch as it forms a continuation of the thorax and contains a portion of the intestinal canal; but not because it is formed of the same rings, or because it encloses, without exception, the same viscera possessing similar functions: observation proving that it is not the same under every circumstance.

In the hexapodal insects the abdomen is well developed, perfectly distinct from the thorax, particularly when that part supports the wings, for in the apterous individuals, that difference is, in default of these organs, rather less marked; the same may be said of the greater number of larvæ, all of which, having the rings of the body equally developed, cannot be divided into abdomen and thorax, if the existence of feet to the three first rings did not sufficiently indicate the respective limits of each of them. It is, nevertheless, impossible to establish this distinction in the apodal larvæ; and if we admit in them a thorax and abdomen, that distinction rests on analogy only. We may then assimilate that provisional state of the insect to the permanent condition of the annelidon, and employ the term body to designate the whole animal, without seeking to establish divisions which cannot fall within our view.

ABDOMINALES. A very numerous and interesting order of MALACOPTERYGEOUS, or soft finned-fishes, and the second in Cuvier's arrangement of the animal kingdom. Their general external character as an order is that of having the ventral fins attached to the abdomen, behind the pectoral ones, and without being attached to the bone of the shoulder.

Though fishes, at least those of the soft-finned division, are classed from the position of their fins, the influence of the differences of position, either upon the character or the habits of the animal, is not very well known. It may, however, be mentioned that the abdominal fishes swim in shallower water than those which have their fins in a more forward position or wanting. Many of them inhabit the fresh waters; and those which are found in the sea avoid the deep waters. The abdominal fins appear to keep the body more steady in troubled waters than is done by those which are situated anterior to the pectorals. The order comprises many genera and species, which may be arranged into the following families :—

CYPRINIDÆ, the *Carp* family,—ESOCÆDÆ, the *Pike* family,—SILURIDÆ, the *Silure* family,—SALMONIDÆ, the *Salmon* family; and CLUPEADÆ, the *Herring* family.

With the exception of the last family, these are almost wholly fresh-water fishes; and they are, generally speaking, wholesome and valuable as food.

ABELE TREE (*Populus alba*, Linnæus). A large deciduous forest tree, indigenous to Britain,

Abele Tree.

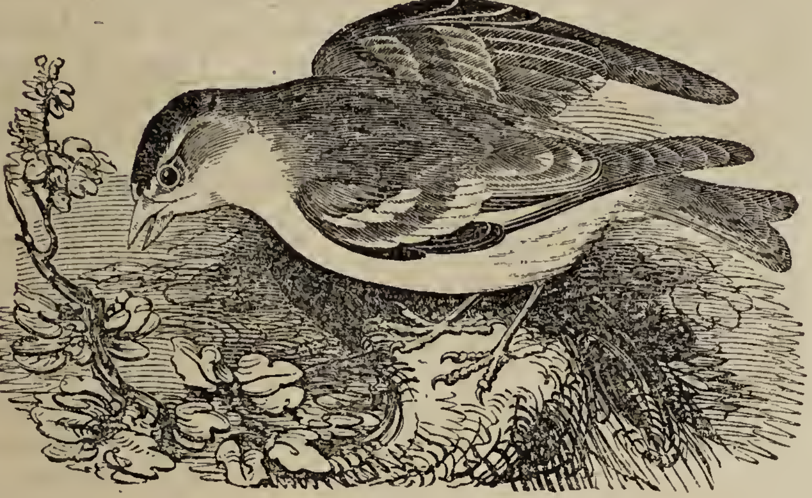
belonging to the Linnæan class and order, *Diœcia Octandria.* Generic character: Calyx one-leaved, five-toothed, bellying; corolla five-petaled, irregularly coloured, inserted into the calyx; capsule three-celled: seeds two, sub-globular, enclosed in a roundish-shaped capsule, opening with three valves. Natural order, *Amentaceæ* (male flowers like catkins) of Jussieu. The height varying from 60 to 100 feet.

This is one of our largest British trees when on its favourite soil, which is a deep bog or peat earth, or a calcareous gravel near the bank of a river or pond. It luxuriates in a superstratum of porous decayed vegetable matter. The roots send up numerous suckers; on which account the tree is injurious near gardens; and on pleasure grounds they are unsuitable, as well on account of their suckers as for the labour they occasion by the fall of their catkins in spring, and the early fall of their leaves in autumn. Its growth is rapid, but the bole seldom exceeds forty or fifty feet in length. The timber is inferior; being light, mild in grain, yet beautifully white. Though subject to the worm, if kept perfectly dry it lasts many years as beams or rafters. Notwithstanding the butts of aged trees are of large dimensions, they seldom turn out well at the sawpit. The lower branches are liable to be broken off by wind; the stumps soon decay, and become a nest for insects, the larvæ of which are sought and burrowed out by woodpeckers; in the holes thus formed the moisture enters, and a rotting cavity is formed, ever increasing downwards: hence the unsoundness of this kind of timber.

The abele cannot be recommended either as a timber or as an ornamental tree: but there are portions of estates where nothing but alders and some sorts of willows will thrive, which may be finely wooded by planting this kind of poplar. The group represented in the previous column must be familiar to many of our readers, forming a beautiful ornament on the banks of the Thames above Richmond.

ABELMOSCHUS. The old trivial name of a species of Hibiscus, and also the name applied to the sixth section of that genus.

ABERDEVINE, or EUROPEAN SISKIN (*Carduelis spinus*, Cuvier; *Fringilla spinus*, Linnæus). A handsome little green and yellow finch, of the genus or division to which the common goldfinch of this country belongs. It is not quite so large as that bird, and the tail is much shorter; the wings are rather long, and are commonly held drooping. The bill is of a pale brown, tipped with blackish brown; the iris of the eye dark hazel, appearing, unless closely examined, black. The feathers on the crown of the head and throat are, in the male, black; but when first put forth, at the general moult in the autumn, they are edged with a greyish brown fringe, which gradually wears off on the approach of spring. Over each eye is a streak of dingy primrose yellow; the neck, back, wings, and tail, olive-green; paler, and more yellow, on the lower parts of the back, towards the tail. The feathers of the back and wings are marked down the middle with a streak of dark blackish green; the sides of the head, throat, breast, and under parts, pale wax yellow, inclining to sulphur yellow; middle of the parts below the breast very pale yellow colour, passing into white; across each wing are two bands of primrose yellow, and between them one of black; part of the quill and tail feathers are edged with pale gamboge yellow; the legs and feet yellowish brown. The head of the female is of a brownish colour, inclining to grey where the male is black; the cheeks and sides of the neck olive-green; and the rest of her plumage is of a more dingy colour than in the male. Among the females very pale varieties are not uncommon. The young, as in most other birds in which the sexes are dissimilar in plumage, resemble in their nestling feathers the old female; the young males acquiring the adult plumage at the first moult, though they do not then become so bright as the older birds.



Aberdevine.

The whole markings of the plumage in this species considerably resemble those of the common redpole linnet (*Linaria pusilla*); the colours, however, are different. Though by no means remarkable for the melody of its song, it is a species highly prized by bird-fanciers, for the purpose of breeding with canaries, with which it readily pairs. It has even been conjectured by some to be the original wild stock of the domestic canary bird, or at most to be merely a marked variety of that species; this is, however, but a mere fancy: the original wild canary (*Fringilla Canaria*) abounds in the islands from which it takes its name, and is now frequently imported into this country; whilst the species now under consideration is a native only of the more northern parts of Europe, descending southward on the approach of winter. It has generally been described, in this country, as a very uncertain winter visitant, occasionally appearing in vast numbers, but at irregular and often distant periods, many years sometimes elapsing between its visits. In the neighbourhood of London, however, these birds are taken very regularly every autumn by the bird-catchers, though in much greater abundance some seasons than in others. Probably, a considerable number migrate to the south of England every year; but as they have not been observed to visit regularly any particular place, they are doubtless often overlooked. They may generally, however, be found, during the winter, in most situations where the alder grows plentifully.

Whilst in these parts, they commonly associate with the small redpole linnet, subsisting, like that species, on the seeds of various trees, especially on those of the alder and birch; but rarely descending, like the goldfinch, to feed on the seeds of thistles. Like most of the other smaller finches, they are fond of the unopened blossoms of furze and of fruit trees, eating the sexual parts of the flowers. They feed also on the seeds of the hop; and as they mostly congregate in large flocks, they have been known to do much damage to the hop-plantations, the places where they have been being easily known by the number of strobiles found lying on the ground. They assume a variety of curious and constrained attitudes when feeding; and are, in general, so intent, as to suffer themselves to be easily taken with a long fishing-rod, smeared at the end with bird-lime. In confinement, the aberdevine is constantly running along the wires of its cage, and when tame, if any thing it is fond of is held to it, it is taken always with the head downwards. If a privet berry, or a piece of almond, to both of which it is extremely partial, be given, it generally places it between its feet, or holds it with one foot whilst picking it, in the manner of the tit genus (*Parus*). The same habit may also be observed in the goldfinch, and in others of the genus *Carduelis*, but not in the linnets (*Linaria*); even the small redpole linnet, which in many respects so closely resembles the aberdevine, has no notion whatever of holding its food with its foot; but if a piece of almond be given to it, will nibble off a small portion, and lay the remainder carefully on the perch beside it, until it is ready for another mouthful. The aberdevine appears in confinement to be very fond of fruit; it eats the pulp only of the privet berry, leaving the seeds; the bullfinch feeds upon the seeds, and rejects the pulp. Like its compeer, the goldfinch, it is a remarkably healthy, docile, and familiar little bird, and its progeny with the canary generally inherit the same good qualities, for which reason they are highly prized by amateurs. Its docility frequently subjects it to the same kind of education as is bestowed upon the goldfinch and redpole, and like those birds it is often taught to perform a variety of little amusing tricks, such as to open the lid of a box containing its food, to draw up its water by means of a little bucket, and to come when called and perch on the hand to be fed. It rarely sleeps upon a perch, but most commonly clinging by one leg to the wires on the side of its cage. Its treatment in confinement should be similar to that of the goldfinch and linnet.

The song of the aberdevine is very similar to that of the goldfinch, though not quite so musical and sweet; it is sharper and more piercing, and finishes always with a remarkably harsh jarring note, which it would be impossible to express upon paper; its common chirp, and call-note, also, considerably resemble those of the goldfinch. When singing, it will often attempt to peck any other smaller bird that is confined with it; with its wings spread wide, its head low, and bill open, it moves about in a very singular manner, threatening its companions, and exhibiting to advantage the pleasing mixture of yellow and green upon its plumage. It is almost perpetually singing; and though by no means a loud songster, its voice may often be heard over those of much more powerful vocalists, from the peculiar sharpness of its notes. Its musical powers, however, on the whole, are not sufficiently fine to render it a desirable cage bird.

Early in the month of March, though in some seasons not until the middle of April, at which time their plumage has acquired its full summer brightness, the aberdevine leaves the south of England for the pine forests of Scotland, in some of which they have been ascertained to breed. The nest, according to M. Temminck, is built among the higher branches of the pine, which accounts for its having escaped the researches of the earlier naturalists. The eggs, four or five in number, are of a bluish white, speckled with purplish red. They begin to reappear in the south about the middle of September, and a few are occasionally taken near the metropolis in their first nestling feathers, which, as before mentioned, resemble those of the adult female. Like the other smaller finches, they are readily caught by means of a call bird, being so fond of each other's society that a party soaring on the wing will invariably alter their course, and descend to the call of a single one from below. They fly in successive undulating courses, alternately rising and falling, and generally utter a chirp at each propelling motion of the wings ; as may be also observed in the linnet and goldfinch, and in most other birds of this family.

ABIA. A genus of insects belonging to the order *Hymenoptera*, and family *Tenthredinidæ* of Leach. The antennæ are short and elevated ; the third joint very long : superior wings with two marginal and three sub-marginal cells. The abdomen of the male has an elongated silky spot on the posterior part, the eyes nearly joining. Two species only of this genus have yet been found in this country.

Sp. 1. Abia nigricornis. Antennæ black : wings from the middle to the apex, with light brown spots : feet light red : thighs black and shining.

Inhabits the alder, and is found in May and June.

Sp. 2. Abia sericea. Antennæ yellow : thorax black and shining, and slightly hairy : abdomen above green and shining, beneath black, the sides green : feet yellow, the thighs black at their base : wings transparent, brown in the middle.

Inhabits the furze, and is found in May and June.

The genus Abia was established by Dr. Leach, in the third volume of the *Zoological Miscellany* : and has been adopted by most authors.

ABIES (Salisbury). The Fir. A genus of trees belonging to the Linnæan class and order, *Monœcia Monodelphia* ; Natural order, *Coniferæ* (conebearing) of Jussieu.

Abies Excelsa. *a.* Male catkin. *b.* Anther, shedding its pollen. *c.* Female catkin. *d.* Scales of female catkin. *e.* Scale of ripe cone. *f.* Seeds.

Generic Character : Flowers, males and females, separate, the former simple ; single catkins bearing blunt stamens ; the latter being roundish catkins, with many two-flowered scales ; cones of various shapes, more or less cylindrical ; scales woody, regularly laid on each other, enclosing the seeds, which are winged.

This conspicuous and useful tribe of forest trees was formerly associated with the pines, but has been separated by modern botanists. The distinctions are chiefly founded on the manner of foliation ; the pines bearing their leaves in bundles, that is, they issue from a little sheath in pairs, or in threes, fours, or fives together ; the firs, on the contrary, bear the leaves singly, or are said to be solitary. There is, however, great affinity in the manner of growth, quality of their wood, and resinous sap, and in their native habit. The silver fir is one of our most stately and ornamental forest trees, rising to a great height, with a proportionate bulk of bole. This, as well as the different sorts of spruce firs, have always an elegant appearance ; they are graceful in themselves, and wherever they stand they enrich the landscape. The hemlock spruce (*A. Canadensis*), so called from the pensile position and light ramification of its spray, resembling in some degree the foliage of the common poisonous hemlock, is one of the largest trees in North America, but from their recent introduction, there are none in this country that have yet arrived at near the natural stature. All the tall ones are ornamental, as well as fit for timber at every period of their growth ; from the period they are mere poles, suitable for fencing, up to the time when their trunks supply beams of any required length. Planted as screens, for shelter, or for nurses to other trees, no other answer the purposes better. Their favourite soil is a dry gravelly loam ; but they will thrive any where in deep, or on well trenched ground. Some of the firs are of humble growth, as the *dumosa* (bushy), and the *Clanbrasiliana* (Lord Clanbrassel) ; such are valuable in ornamental planting.

All the sorts are raised from seeds sown in the spring, and afterwards transplanted, first into beds, and in a year or two into rows, to gain strength before final transplantation.

For an account of the more useful or ornamental species, and the best mode of culture, see Fir Tree.

ABIETINEÆ (Richard). A subdivision of the Coniferæ or Fir Family, which includes the genera *abies*, the fir or spruce ; *larix*, the larch ; and *pinus*, the pine. For a description of the tribe, see Coniferæ.

ABILGAARDIA (Vahlenberg). A small grassy-looking plant, a native of New Holland. Linnæan class and order, *Triandria Monogynia ;* Natural order *Cyperaceæ*. This species differs from the rushes in having the scales of the flowers placed in two imbricated ranks ; by its pointed seeds and the three-sided base of its style. There are only two species, both greenhouse perennials, viz. *A. Monastachya*, one spiked ; and *A. Tristachya*, three-spiked.

ABRÆUS. A genus of insects of the order *Coleoptera*, and family *Histeridæ*. The antennæ are geniculated, and terminated by a nearly solid club of three articulations ; the basal joint of the antennæ somewhat elongated, second and third nearly cylindrical, straight ; fourth short ; fifth, sixth, and seventh, nearly globose and equal ; eighth, nearly globose, lenticular ; ninth, tenth, and eleventh, forming a short oval club ; elytra shorter than the abdomen, the margin of the sides inflexed : body thick, nearly globose or quadrate ; tibiæ elongated and straight ; tarsi with five joints, long, slender and contractile ; sternum simple.

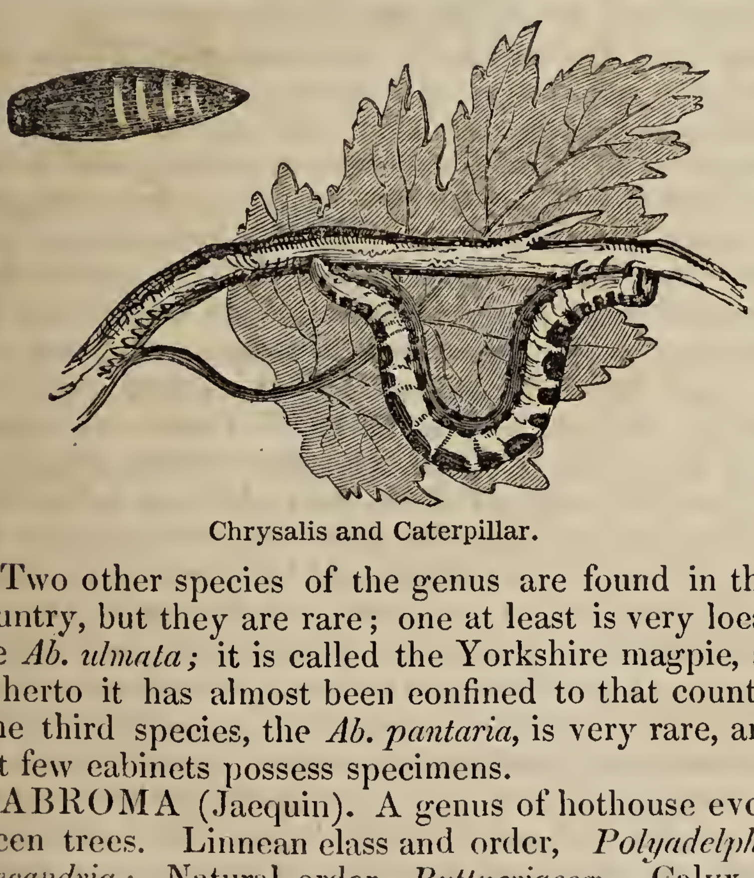
This genus was established and the character laid down by Dr. Leach, in the third volume of the *Zoological Miscellany;* it contains two species, the Ab. globosus, (Hister Perpusillus, Marsham's Coleoptera, and the H. Minertus; they are found in the dung of cattle in the early spring months.

ABRAXAS. A genus of insects of the order *Lepidoptera*, and family *Geometridæ*. The antennæ are simple, not fringed: body slender: palpi scarcely hirsute: wings, when at rest, extended horizontally, neither angulated nor indented. larva or caterpillar with ten feet. This genus was separated from the *Geometria*, and named by Dr. Leach. There are three species found in this country; one of which, the *grossulariata*, is very destructive to the gooseberry plants in our gardens, and begins to consume the leaves and injure the plants almost as soon as the leaves appear. We should recommend, for the destruction of them, that the plants be examined early in the morning, before the dew is off or the sun has much power, to seek for or collect them, as they feed at this time, and may be easily detected: poultry will feed on them with avidity, as indeed they will on most caterpillars.

Ab. grossulariata, common magpie moth. Wings white, the upper or superior with the base, and streak towards the hinder margin yellow, with six rows of round black spots, more or less confluent; lower or inferior wings with a few scattered spots in the middle, and a streak of the same beyond the middle, and a row on the hinder margin; body yellow, with rows of black spots; expansion of the wings one inch eight lines to two inches; appears in the perfect state about the end of July.

Magpie Moth.

Caterpillar, with ten feet, white, with a yellow line down the side, and numerous rows of black and irregular spots and dots. Chrysalis or pupa suspended by a thread, black with yellow bands.



Chrysalis and Caterpillar.

Two other species of the genus are found in this country, but they are rare; one at least is very local, the *Ab. ulmata;* it is called the Yorkshire magpie, as hitherto it has almost been confined to that county. The third species, the *Ab. pantaria,* is very rare, and but few cabinets possess specimens.

ABROMA (Jacquin). A genus of hothouse evergreen trees. Linnean class and order, *Polyadelphia Decandria;* Natural order, *Byttneriaceæ.* Calyx of one sepal, persistent, cut into five deep clefts; corolla pentapetalous, concave, arched; stamina six, united at the base into a globular pitcher; some of them destitute of anthers; styles five; capsule pointed, of five places and five salient angles, opening at the top, with many kidney-shaped seeds. Of this genus two species are described; viz. *A. Augusta,* smooth stalked; and *A. Fastuosa,* prickly stalked. Both very elegant East Indian shrubs.

ABRONIA (Jussieu). A genus of evergreen creeping perennials, natives of California. Linnæan class and order, *Pentandria Monogynia;* Natural order, *Nyctagineæ.* The flowers are borne on the points of the axillary peduncles; calyx tubular, coloured, limb in five divisions, stamens five; ovary of one place, and one-seeded, forming a five-angled fruit, which is covered by the persisting base of the calyx. There are only two species, viz. *Mellifera,* honey-bearing; and *Umbellata,* umbelled.

ABRUS (Wild Liquorice). A genus belonging to the natural order *Leguminosæ,* and to the Linnæan class and order *Diadelphia Decandria.* Generic character: Calyx of two lips, the upper of one lobe, the lower of three; corolla irregularly butterfly-shaped; stamens ten, nine united and one apart; fruit of one place, filled with beautiful pea-shaped scarlet seed, with a black scar. The only known species is the *Abrus precatorius,* or Prayer Liquorice. This is a deciduous climbing plant found in Jamaica, the roots of which are used in the same way as liquorice. It furnishes those scarlet seeds, familiarly known under the name of crabs' eyes, which are worn as necklaces and used as rosaries. From the latter circumstance, the name Precatorius or Prayer has been derived. These seeds are said to be eaten in some countries, but are very indigestible.

ABSINTHIUM. The old trivial and now the specific name of the common wormwood. It is also the name of one of the sections of the genus Artemisia.

ABSORPTION. A species of natural action, the knowledge of which is essential to the understanding of a vast number of natural truths, and the explanation of a still greater number of natural phenomena. It is the power which one substance has to receive another, diffused through its mass, without being thereby decomposed. The substance which receives or imbibes the other is called the *absorbent,* and usually styled the active one; but the action is reciprocal, though different.

Absorption takes place in all the kingdoms of nature, though some of them at least are specifically different in each of the three; and there are many degrees and modifications in each. The action is not very easily defined, but it may be regarded as one between the surfaces of the small parts of the two bodies; and one of the bodies, at least, must be in the fluid state. When the two bodies are in the same state, that is, both liquids or gases, or solids in a minute state of division, there is no absorption, it is mixture; but a liquid may absorb a gas, and a solid may absorb either. When the denser body unites with or disperses itself through the rarer, as when spirit, oil, or water, is dispersed invisibly through the air, the process, though an important one in the economy of all the kingdoms of nature, is usually described as a chemical one. But in the mere act of absorption, or that of evaporation, the nature or composition of the absorbed substance is not understood to be changed. In nature, therefore, absorption is the act of producing a new compound, by bringing one of the parts within the other's range of action.

When the process extends no further than absorption, it belongs to chemistry, and not to natural history, for chemistry holds the same place in the mineral kingdom which physiology does in the animal and the vegetable; and as in these absorption is only one part of the physiological process, and that a preliminary one, which in itself produces no result, the modification of it can be better explained in treating of those ultimate actions to which it is preliminary.

When the absorbed substance is a liquid, it is generally taken up by vessels which are, from the offices which they perform, called *absorbents*, or by apertures in a membrane, which are called *pores*; but there appear also to be absorbing surfaces, in which no pore is discernible either by the eye or the microscope. Plants absorb water by the *spongelets* or little sponges, upon the *rootlets*, or young fibres of their roots; but they also absorb by their leaves, and, in many instances by their whole surface, even though, when examined by the microscope, what appear to be pores on their surface seem rather to be *culs de sac*, or small indentations, lined throughout with the unbroken epidermis of the plant. When a plant thus absorbs, it revives; and the same takes place with animals, and even with man himself. If one who is parched with drought stand over water, and especially with the bare feet immersed in it, thirst is allayed, and the body recovers its tone, in a manner similar to that in which a lopped twig or a pulled flower recovers, when it is sprinkled with or dipped in water, or when the stem of it is placed in that fluid.

There are, in the case of the human body, some other circumstances, which not only prove the existence of an intellectual principle, totally different from the body, but which show that that principle can, of itself, to a certain extent, sustain the body and allay its anguish. When one has been long upon the dry hill, fatigued, exhausted and parched, the sight of a running stream, or even the sound of a waterfall, will revive the spirits, and bring at least a momentary relief, as the author of this article has often experienced. The duration is, no doubt, fleeting; and though the observations of Shakspeare are as philosophic as they are practical, for—

> "Who can hold a fire in his hand,
> By thinking on the frosty Caucasus?
> Or wallow naked in December's snow,
> By thinking on fantastic summer's heat?"

yet still, such is the power of the mind over the body, that both the eye and the ear can absorb relief, in cases where there can be no material contact.

In the action of vegetables, the whole preliminary part of the process appears to be absorption; and, though in many instances the mode eludes our most careful observation, they can, in the greater number of the species, feed at the whole of the active surface when in leaf, they do not in any instance take food into an organ at all analogous to what we call the stomach in animals. From this, it should seem that, with them, nourishment passes more immediately to organisation, without the process of assimilation. Excepting in the case of poisons, which both plants and animals seem capable of absorbing, and which they absorb at different parts, according to their nature, plants do not appear to take into any part of their system substances which are not wholly available for the purposes of vegetable life and growth. They no doubt give out gases, and different ones, according to circumstances; but there is still a difference of opinion even amongst the most eminent botanists as to whether they give out any excrementitious matter, either in a solid or a liquid state; and the gases which they give out bear more resemblance to those given out by animals in respiring, or in some other process posterior to assimilation, than to the matters which are rejected by the animal system in that process.

The power of absorption, in organised substances, increases nearly in the ratio of the complexity of their organisation. Plants absorb less than animals; and among these those of the simplest structure absorb the least. There appears to be, in the living subject, only a very limited power of election of what matter it shall or shall not absorb. Absorption can separate mechanical mixtures; but it is doubtful whether it can effect any chemical solution. Air and water are the substances most generally absorbed by the external surfaces both of plants and of animals; and in the case of water, any foreign substance with which it happens to be mechanically mixed is generally left behind. When sailors are long exposed without water they can quench their thirst by plunging themselves into the sea, or by wetting their clothes with sea water; and if the relief is obtained by so wetting the clothes for a long time, these become impregnated with salt to a much greater extent than if they had been kept the same length of time in salt water, without being in contact with the absorbing surface of the body. If, when one is in a boat at sea in very hot weather, the arm, even the hand only, is placed in the water, an agreeable freshness diffuses itself over the whole body, and the part immersed gradually becomes covered with an incrustation of salt.

The sea fogs, which are evaporated, especially from flat beaches upon which the tide water alternates, in the early part of the season, can hardly be said to be salt; but when they settle upon vegetables, the leaves and other surfaces of these absorb the water, and the salt remains, so that, after a few hours of a thick fog, it is very perceptible to the taste. Up to a certain point, that process is wholesome; and the crops and hedges seem as much revived as if the humidity had descended limpid from the sky; but if it continues long, and the sun breaks out so as to evaporate the remaining moisture quickly, the salt corrodes and destroys the leaves. It appears to do that more readily and completely in proportion as the leaves are of a more absorbent structure; and hence the difficulty of getting many species of plants to grow, if exposed to the sea air. City fogs have even a more pernicious effect upon vegetables than saline fogs from the sea; because the salts with which they are loaded are of a more caustic nature; and because some of them are absorbable by the plants, and thus, though they do not instantly kill them, they injure their qualities. Culinary vegetables which are grown within the reach of those fogs are very inferior in flavour to those grown in pure air, even though the soil and mode of treatment may be very much inferior.

Evaporation, or the taking up of humidity by the atmosphere, is a species of absorption, and follows the same law. Common salt does not rise and mingle with the air in that process; but the more pernicious matters which pass into the state of gas at low temperatures do; and hence the invisible vapour which rises from the sea is usually limpid and wholesome, while the effluvia of marshes and other places, where organic matter is in a state of decomposition, taints the air with poison.

The action of the air upon plants, and upon animals in breathing, appears also to be analogous to absorption—to be, in fact, the identical process; and as the *nitrogen* of the air seems to be only the vehicle in which the oxygen is in these cases conveyed to the plant or the animal, we may thence infer that those two component parts of the atmosphere are merely mechanically mixed, and not chemically united. That holds in the case of animals which breathe water by gills, as well as in that of those which breathe air by lungs; for the fish cannot live in water that has been wholly deprived of air, any more than a land animal can live in an exhausted receiver. It is a general law of nature, to which there are no known exceptions, that combination can be separated but by some action more powerful than that by which it was united. But the formation of water from its elementary gases, oxygen and hydrogen, has not, in any instance with which we are acquainted, taken place without an intensity of action, which no known plant or animal, or any part of the one or the other, could bear; and, therefore, we cannot reasonably believe that any of them can decompose water, so as to avail themselves of either of its elements, by any process at all analogous to absorption, whether by the surface generally, or by any specific surface, such as that of the cells of lungs, or the fibres of gills.

Hence, in what part soever of nature it takes place, we must regard absorption as a merely mechanical process—an action as between surface and surface, in which, how minutely soever the substances may be mixed with each other, there is no chemical action,—no decomposition of an old substance, and no formation of a new one.

In vegetables the process is simple, and it appears to be the only one by which matter is added to the leafy part of the vegetable. They receive their food wholly by absorption; and the process of assimilation takes place afterwards. In animals the case is different; for though the surfaces of most animals are capable of absorbing, and the matter which they thus absorb sometimes, in part at least, serves as food; yet the food, properly so called, of even the most simple animal, is first taken into some sort of a stomach, and there assimilated, before it is absorbed.

There is still this further distinction between absorption in vegetables and in animals, that all which the vegetable absorbs goes to additional growth or increase of substance, either in the structure of the individual plant, or in the formation of seeds, or other germs of new ones of the same species. Plants, no doubt, give out gases; but there is not in any plant a means of taking up the waste of the system, and replacing it by new matter. Plants do, under peculiar circumstances, form accumulations of pulpy or starchy matter, which is sometimes called vegetable ALBUMEN; and the act of cultivating vegetable substances for food chiefly consists in making them produce useful nutriment, rather than stems and leaves; but still, there is no power in the vegetable to absorb that which has once formed part of its original structure, and replace it by new matter, which shall again perform the same function, as is the case in the animal economy. When the sap of the year has once granulated into cambium, and that cambium has ripened in the autumn into wood and bark, there is no return of it to the living action of the tree. It lingers for a longer or shorter time, according to the species, as ALBUMEN, before its final consolidation into "heart wood;" but when its one season is passed over, it buds and blossoms no more; and thus, how long soever the tree may last, it is still but an annual, as a growing vegetable of the same localised matter. Some trees, indeed, have the power of obliterating the remains of small lateral branches, after new layers of wood have grown over them; as we find many trunks of pines and other trees without any appearance of knots in the wood, though we know, from the habits of the species, that they must have at one time been branched at short intervals, all the way from the root upwards. But the obliteration of these and also of the pith in many trees takes place in the wood, where we cannot examine it, and therefore we cannot say whether it is produced by absorption or by simple pressure. Generally speaking, vegetables have not the power of removing any part by absorption, however much that part may disfigure or injure their system; the gnarl upon the bole of the deciduous tree, and the union of shoots which sometimes produces so singular an appearance in pines, are never obliterated. In animals, on the other hand, there appears to be an almost unlimited power of absorption. The waste of all parts of the system is continually taken up; and many unnatural accumulations of matter are absorbed by the action of the system, without the aid of any artificial application.

In many subjects, both animal and vegetable, there are seasonal accumulations of matter, which are again absorbed, as will be explained at length in the article HYBERNATION; and in some animals there are accumulations at certain ages, which are absorbed for the support of the system when the powers of assimilation begin to fail, or when they are weakened by disease. These absorptions extend not merely to the fat of the animal, but to all the soft parts; and it is truly said of certain diseases and conditions of the body, that they "eat the flesh off the bones." Nay, the bones themselves do not escape the ravages either of disease or of time; for that bending of the body and shortening of all its dimensions which take place when, in the extreme of life, man passes into "the sere and yellow leaf," are occasioned by absorption of the bones—not merely of their cartilaginous part, but of the salts of lime; and this absorption is sometimes so excessive, that the lime thus taken into the circulating blood is precipitated upon the coats of the blood vessels, and even upon the heart itself, forming what are termed *ossifications*. There have been instances in which one part of the body has had the blood vessels thus converted into tubes of bone, while the rest retained the power of all its functions; and also instances where, in consequence of ossifications of the heart or the proximate vessels, the system has repeatedly stopped till put in motion by the application of ardent spirits or other strong stimuli; from which it appears that absorption is among those functions of the animal system which last the longest. It is indeed very probable that absorption continues even after life is extinct; for though it takes place largely in the living structure, it cannot be said to be, in itself, a function of life, or a display of the living principle. While the living principle maintains its activity, it controls the power of absorption; and the different tissues with which the several parts of the body are covered have it in different degrees. The coating of the internal parts of an animal absorbs in a manner quite different from that of the external. There are many substances which, taken into the stomach, or exposed to any of the internal surfaces, act as poisons, in which the hands may be washed with perfect impunity; though there are others, the absorption of which by any part of the body is equally deleterious. But as the internal surfaces are the most delicate, it may be presumed that absorption, especially that of noxious gases, takes place most readily at them. In most cases, however, the absorbing surface performs other functions, such as that of secretion; so that it is not very easy to ascertain whether greater injury be done by the mere absorption of the offensive matter, or by the direct action on the surface at which that matter is absorbed.

The readiness with which the surfaces of animals, especially the inner surfaces, absorb different substances, is the means of much good as well as harm; and most medicines which are what is termed alterative, or intended to produce a gradual change in the body, without any violent or specific action of the intestinal canal, produce their effects by being absorbed. It is to be understood, however, that the effect is not in the mere absorption, which is a mechanical process, but in some subsequent action; and that action sometimes very rapidly diffuses itself over the whole body.

ABSTINENCE literally means voluntarily refraining from taking food; but it is often applied to all cases where food is not taken, in what may be considered the average quantity, whether voluntarily or not. This is the sense in which it is used in natural history, and as such it is an important branch of the physiology both of animals and of vegetables. It stands opposed to repletion, or excessive feeding, and the wholesome state for both animals and vegetables lies between the two; but the precise point in any one instance is a matter to be determined by actual observation of that particular instance.

That different plants have different capacities for food, and that these capacities fluctuate with the seasons, and other external circumstances and agencies to which the plants are exposed, must be obvious to every one who has paid the slightest attention to the progress of vegetation. It must also be observed by every one that, in the same species of plant, the quantity and also the quality of the matter elaborated depend very much on the quantity of food. If it is in rich soil and exposed to a damp atmosphere and moderate warmth, the produce is very great; but the parts are soft and spongy; and if any part of the plant be used as human food, that part is crude, tasteless, and does not, in the same weight, furnish so much of even less palatable nourishment as that which is grown with more moderate feeding. This principle is general, and it is a most important one in that first of all arts, the cultivation of vegetables; but it must be received with some explanations. Plants are naturally adapted to different situations; some to the waters over which the air is constantly impregnated with vapour; some to the arid places, where there is little moisture either in the air or the earth; and there are habits intermediate between all these. In every case, however, there may be discovered a medium state, which is better suited to the whole action of the plant, than if it were either more highly fed or subjected to greater abstinence. When we cultivate, either for human food, or for that of domestic animals, it is not the whole plant that is our object so much as some product of it; we seek, for instance, to produce more succulent or farinaceous matter in the seed, the bulb, the tube, the stem, or the leaves; and up to a certain point of forcing, by prepared soils and manures, and by sheltering from the cold and violent currents of the air, we attain our object; but there is always a limit, which if we once pass, we defeat our object; the functions of the plant are impaired, it ceases to be fertile, and it becomes unable to bear even moderate changes of temperature. The ultimate seasonal action of every plant is the ripening of the seed; and before that is perfected the action of growth as increasing the quantity of matter in the plant ought to cease also. Those plants in which several fructifications are in progress at the same time—as the orange among the trees of rich soils in warm climates, and the common juniper among the shrubs of cold and rather sterile places—are exceptions, though in them each succession of fruit obeys the same law as those which bring forward but one crop at a time; and it is found that when planted in a soil too rich and warm, the juniper not only remains sterile, but is difficult to be kept alive.

In annual vegetables, the cultivator can adapt the soil to the plant by experience; and it is there found that change of place will correct the bad habit which the plant in time acquires, either from too rich or too poor a soil. Seed corn from the hill runs less to straw and yields better on the rich and sheltered bottoms; and seed corn from these grows stronger and ripens earlier on the hill. It is the same with bulbs and tubers, and indeed with cultivated plants generally. One cultivation stimulates one part of the system of the plant more than it does the other parts; and as the seed must partake of the artificial qualities (the qualities produced by locality and culture) of the plant upon which it is grown, the change from soil to soil tends to restore it back again, by, on the one hand, repairing the exhaustion which had been produced by abstinence, and on the other correcting the surfeit which had been caused by repletion. Shortening the duration of plants is one of the effects of high culture; and though we have no data for ascertaining the early history of the grain plants and pulses which are now known only as cultivated, it is by no means improbable that they all have at one time been perennials; and the fact of their being capable of multiplying by the roots, is at least a strong presumptive proof that such has been the case; though it appears that now they have lost so much of their original character that they are unable, without the assistance of human art, to bear the common succession of seasons in our climate for longer than a year or two.

In plants of longer duration—trees for instance—whether cultivated for their fruit or their timber, the principle of abstinence cannot be so well applied; and as in both large growth is the main, because the marketable, object, the chief efforts are in the other direction—to produce quantity as rapidly and as abundantly as possible, and let the quality be as it may. In general, however, it is best when the seed is gathered from a plant on average soil, and the nursling reared in the same. But on the whole, *abstinence* has been very partially applied in the cultivation of vegetables; though the general principle of its action be plain enough, the details have not been sufficiently studied.

In animals, especially those species of them which are the most familiar to our observation, the effects of abstinence are better known; though even these are so varied in different species, that it is not easy to generalise them. As an animal, at least one of the warm-blooded classes, is a much more complicated organisation than a vegetable, it follows, as a matter of course, that both abstinence and its opposite must have more effect upon the animal system. Abstinence in the young or growing stage will, as a matter of course, diminish the size of the animal, just as a thin and hungry soil diminishes the size of a plant. But the opposite treatment cannot carry the opposite effect to the same extent in the animal kingdom as in the vegetable. The reason of this will at once become obvious, when it is considered that the food of the plant, whether obtained through the medium of the soil or the air, is taken immediately into the substance of the plant by absorption; while, of the food of the animal, it is the liquid portion only which is absorbed, and that too but in part; and also that the part absorbed, if it exceed a certain limit, injures the power of assimilating the rest of the food, and thus produces some of the effects of unhealthy abstinence. Fat animals are not the most ravenous eaters, whether the eating take place at long or at short intervals.

When the health, comfort, and activity of the individual are the objects, which is the case with men, and with all the working animals, an accurate knowledge and judicious use of the principle of abstinence are of the very first importance; for if the simple organisation of the vegetable can be so acted upon by excess of food as that one part of its system shall get the better of the other parts, and produce one of the natural components or products in much greater abundance than the others, much more must it happen with animals, and especially with those of the more complicated organisations.

The food of the animal, even during the period of its growth, goes to replace the waste of the body as well as to increase its volume. The digestive power consequently requires more frequent supplies during the period of growth than after the body has attained its full dimensions; but though the supplies require to be more frequent, there is even more danger of excess than where the body has attained maturity; because the same degree of gluttony, which emaciates the body and takes the colour of health out of the cheek in after life, as certainly both stunts and deforms the growing subject. Nor is that all; for, from what has been stated of the excessive action of one part of the system diminishing that of all the rest, the pampered youth must, as matter of course, grow up, as one would say, "brainless in science, and handless in art." When young people have free range in the open air, they make solid bones and firm flesh upon even abundant feeding, just as trees on a rich soil make good timber, when the breeze of heaven plays freely around them; but it sometimes happens that the good feeding is purchased by the sacrifice of that exercise which would render it wholesome; and then they necessarily grow up much in the same manner as poles in those thick plantations where they are choaked and etiolated by their own closeness, and will not last for even a year when they are put to the test as timber.

In old age, when the power of assimilating has begun to fail in proportion to that of absorption, and there is a tendency in the body to take up its own matter in the circulation, abstinence has a direct tendency to increase the evil; and it does so the more as, at that period of life, the feeling of hunger is not so vigilant a monitor as when the system is in a more vigorous state. Hunger is the call for assimilation, not for absorption; and as the absorption is the more energetic of the two at that age, a partial inroad may be made upon the system before hunger becomes keen. It has been remarked, that old men who do not eat except at long intervals, sooner become bent in the spine, and stiffened in the joints, than those who do not eat more on the whole, but do it more frequently.

Throughout the whole of animated nature, it is a law that those animals which can bear the most copious feeding at one time, can also bear the longest abstinence; but it is also accompanied by another law, that where there is the most intense action, there must be the greatest supply of food to maintain that action. Something, too, depends on the nature of the food. Animals which feed upon leaves continue eating during the greater part of the day; those that feed upon seeds eat less frequently; those that feed upon other animals less so; and the preyers on warm-blooded animals the least of any. But in all these, the amount of quietude and repose after the meal obtained are always in proportion to the power of abstinence. The more powerful of the predatory animals, whether mammalia or birds, are never found sporting. When their hunger is appeased, they lay themselves down to rest—the lion stretches himself in his den, the eagle squats on her ledge, or rests balanced on her pinnacle, and all the weaker animals are at peace, or at least in freedom and safety, till the lord of the desert or the queen of the cliff again comes forth to feed.

These general observations, which can be much better expanded into their particular details in treating of those animals of which they are characteristic, tend to show how very beautifully all the parts of nature work together. In man, we find that the years of his life, during which he can bear the most hearty meal and the longest abstinence, are also those in which he is called upon to perform the duties of life with the greatest energy and the least interruption; and that as we look nearer either to the commencement of life or its close, we find that this feebleness of the system of the body is indicated by the more frequent calls for nourishment. In the predatory animals again, the repose after they are fed gives peace and safety to the rest of the creatures; and the lion spares the flocks on which he feeds as much, and nearly from a similar cause, as man does,—though in the case of the lion it is merely an instinct of the animal, yet it is as much a law of his nature as his other habits, or even his form; while with man it is matter of reason and experience.

There are many very interesting points in the natural history of particular animals closely connected with the powers which these have of enduring abstinence; but they either belong to the peculiar organisations of the species in which they are manifested, or they are of a climatal or seasonal nature, and as such can be noticed with more advantage in the article Hybernation, and in those on the seasons during which they take place. There are also many singular instances of abstinence in human beings, some of them what are called voluntary and others involuntary, some well authenticated and others doubtful; but though these, to a certain extent, show the flexibility of the human system to circumstances, they do not come within the legitimate province of Natural History.

ABUTA (Aublet). A genus of evergreen climbing plants. Linnæan class and order, *Diœcia Polyandria;* Natural order, *Menispermaceæ*. Of this genus there are only two species described, viz. *A. rufescens*, rufescent; and *A. candicans;* both natives of Cayenne.

ACACIA. An extensive genus of exotic trees and shrubs belonging to the Linnæan class and order *Polygamia Monœcia;* and to the natural order *Leguminosæ*, division *Mimoseæ*, of Jussieu. The name is derived from the Greek word ἀκαζω, to sharpen, in consequence of many of the species being thorny. Generic character: flowers, polygamous; calyx, four or five toothed; the petals of the corolla four or five, at one time free, at another coalescing; stamens varying from ten to 200; pods not jointed, juiceless, and two-valved.

Branch of the Acacia.

The species included under this genus are very numerous, amounting to about 300. They are shrubs and trees, varying in habit and foliage; and while by their beauty and elegance they contribute not a little to adorn the countries in which they grow, they are found to be of essential service in the arts and manufactures by supplying them with a hard and durable wood, which is deservedly much valued. They are found in the tropical regions of Asia, Africa, and America, and also abundantly in New Holland, Van Diemen's Land, and New South Wales. They all bear pods like the pea family, but in their blossoms they have a considerable resemblance to the willow tribe. By their airy foliage and golden flowers they throw a charm even over the sterile deserts of Africa:—

> "Our rocks are rough; but smiling there
> Th' acacia waves her yellow hair;
> Lonely and sweet, nor lov'd the less
> For flow'ring in the wilderness."

The leaves are, as we have already stated, in the greater number of the species, pinnate, that is, having a central stalk and numerous small leaflets on either side of it, as represented in the engraving; in others, however, the leaf-stalks become dilated vertically into hard, leathery expansions, denominated *Phyllodia*, which seem to serve all the purposes of leaves, and which in their young state generally bear leaflets. From this difference in the foliage, the species have been divided into those having pinnate leaves, and those provided with *phyllodia*. The latter are of frequent occurrence in New Holland and the other parts of Australia, and may be said, in some degree, to characterise the vegetation of those countries.

We shall notice a few of the important species. The *Acacia Arabica, vera, Senegalensis,* and *Nilotica,* &c., are interesting in a commercial point of view, as yielding the substance called Gum-Arabic. This exudes either spontaneously or from incisions made into the bark, and subsequently hardens by exposure to the air. When pure it is transparent and colourless, has neither taste nor smell, and is perfectly soluble in water, forming what is called mucilage. Gum Arabic derives its name from having been originally brought from Arabia; subsequently, however, Africa, more especially Senegal, has furnished a considerable quantity. From this circumstance the name of Gum Senegal has been given to some varieties. The Gum Arabic tree is also found in the East Indies. The gum is collected in the months of December and January, and sold in large quantities to French and English merchants. It is capable of being used as an article of food, and is very nutritious. During the time of the gum harvest the collectors subsist upon it entirely, and six ounces are said to be the usual allowance for an adult, in the course of twenty-four hours. Gum is used extensively in medicine, as a bland mucilaginous substance, for the purpose of allaying various irritations. It is made into the form of lozenges and jujubes with several other substances. It is useful in the arts, being employed in calico-printing to give consistency to colours, and to prevent their spreading. For similar reasons it enters into the composition of writing ink, blacking, &c. Botanists employ it to fix the dried specimens of plants upon paper, and it is used in the formation of numerous fancy and ornamental articles, such as seals, rice boxes, &c. The bark of the Gum Arabic tree is employed in India as a tonic for strengthening the stomach, and a decoction of its pods serves for the purpose of washing.

Another species of Acacia, the Acacia Catechu, or Khair tree, a native of the mountainous parts of Hindostan, deserves notice chiefly on account of its yielding a substance which is used in medicine. This substance, which was formerly erroneously denominated Japan Earth, but now receives the name of Catechu, is an extract from the internal part of the wood of this tree prepared in Bengal, and other parts of India, by decoction and evaporation. The extract is also prepared from the pods of the tree, as well as from other plants, such as the Nauclea Gambic and Areca Catechu. It has a reddish brown colour, and its taste is very astringent. On account of its astringent property, it is used in various diseases as a medicinal agent of considerable efficacy.

The Acacia discolor, and several other species known in Van Diemen's Land, under the general name of *Wattle*, furnish much of the timber used in that part of the world.

From the bark of the Acacias, found in Van Diemen's Land, more especially the Acacia decurrens and mollissima, an astringent extract was lately prepared and imported into Britain for the purpose of tanning leather. It was found, however, that the expence of the extract was far too great to render it a marketable commodity, and the bark itself is therefore now substituted. Occasionally a quantity of the Mimosa Bark, as it is termed in commerce, is imported into London. The bark is of little value in Van Diemen's Land ; and although the freight and duty are considerable, still so long as the Acacias continue to be cut down, in that country, for the purpose of clearing the ground for cultivation, the price must remain in some degree moderate. The Mimosa Earth is more astringent, and possesses a more powerful tanning property than the oak bark, but it imparts to the leather a reddish tint, which renders it fit only for sole leather. The Mimosa Bark, however, when mixed with acorns, may be used for the tanning of dressed leather.

The Acacia decipiens, found in New Holland, was formerly mistaken for a fern, and called fern-tree, on account of its long flowerless branches. The Acacia melanoxylon, denominated in Van Diemen's Land, Black-wood, is a beautiful tree, with foliage reaching to the ground. It grows to a considerable height, but does not attain a great diameter. Of late years various new species of acacia have been collected in Australia, by Mr. Allan Cunningham, Mr. Fraser, and Dr. Leber.

The acacias are propagated by seeds, or by cuttings put into sandy soil, under a bell-glass, and kept warm. The flowers of some of the species of acacia are used by the Chinese for dying a yellow colour.

In our shrubberies the Robinia Pseudo-Acacia, or Locust-tree, an elegant shrub, bearing white pea-shaped blossoms, occasionally tinged with pink, is commonly cultivated under the name of Acacia.

For the better distinguishing this numerous family botanists have arranged the species into five divisions, founded on their different modes of foliation, and these divisions have again been subdivided into sections, founded on their manner of flowering, or on the absence or difference of their armature. A few of the species are climbers, and many, indeed a whole division, are marked *dubiæ*, not being sufficiently known to distinguish to which section they belong. The name Acacia has also been given to many other species of plants, viz. to a species of Darlingtonia, to a Gagnebina, and to several of the genus Prosopis.

ACÆNA (Vahlenberg). A genus consisting of ten species of curious evergreen herbaceous exotics, chiefly from South America, towards the Straits of Magellan and New Holland. They belong to the Linnæan class and order *Diandria Digynia*, and to the natural order *Rosaceæ*, tribe *Sanguisorbeæ*.

ACÆNITUS (Latreille). A genus of insects of the order *Hymenoptera*, family *Ichneumonidæ*. Generic character: superior wings, with the first sub-marginal cell very large; the two discoidal cells situated longitudinally, one above the other; mandibles bidentate, or notched at their extremity ; palpi with their joints not very unlike each other; oviduct covered at its base by a large scale.

To this genus belongs the Ichneumon dubitator of Panzer's *Fauna Insectorum Germanica*. It is certainly a rare species in this country; but the insects of this family have been greatly neglected by entomologists. Gravenhorst, in his work on the Ichneumonidæ, has enumerated seven species. Many of the ichneumons may be found on umbelliferous plants, upon which the respective species deposit their eggs ; and it would be highly desirable if we could identify the larvæ, for there is no doubt, from what we have observed, that each caterpillar has its own peculiar parasite, and that nothing is left to chance. The rarity of many of the moths in the larvæ state will also account for the scarcity of certain species of this family of insects.

ACALEPHA. Animals forming the third class of Cuvier's *Zoophytes*. This name is given to them from the faculty several of them have of stinging the hand when touched. Their form is always circular and radiated, and their organisation complex. Their mouth serves also as an anus ; their stomach, being in the form of a sack, is sometimes prolonged in radiated intestines, through different parts of their body. These, probably, replace the vessels they otherwise are deficient of. They are divided into three families. The fixed species include the *Anemonies*, the *Zoanthes*, and the elegant *Lucernaria*, belonging to this class.

The free species float on the sea, and their brilliant legions cover an immense extent with phosphorescent light during the absence of the sun.

Another species is the *Hydrostatic ;* which are so called from having one or more bladders filled with air, by means of which they remain suspended in the water.

Lamarck has separated the Acalepha into the different sections of the two orders, which form his third class of invertebrated animals, called *Radiata*.

ACALLES (Schönherr). A genus of insects of the order *Coleoptera*, family *Curculionidæ*. Antennæ genitucated, twelve jointed, rather stout ; funiculus seven jointed, its two basal joints obconic ; the remainder subrounded, and slightly coarctate ; the club short, ovate, acuminate. Rostrum longer than the thorax, stout, a little bent, inserted during repose in a deep elongate pectoral groove, which is strongly margined: eyes minute: thorax rather long, convex, lobate behind the eyes, narrowed in front, the base truncate: scutellum wanting: elytra connate, subgibbous, embracing the sides of the abdomen : legs rather stout, the intermediate pair shortest ; tibiæ slightly compressed, the apex furnished with a stout tooth within.

Ac. Ptinodes. Piceous ; with scattered cinereous scales above, and erect muricated black spinulose ones : eyes brown : thorax deeply punctate : elytra dilated before the middle, attenuated posteriorly, deeply and coarsely punctate-striate ; variegated with cinereous; beneath rufo-piceus, densely clothed with cinereous scales : legs and rostrum rufo-ferruginous : antennæ pale testaceous.

Curculio Ptinoides *Marsham*, length one line and a quarter.

Inhabits sand pits and gravelly places, at Coombe Wood, Surrey ; Darenth, Bexley and Charlton, in Kent. The above situations may be searched in the months of April, May, and June by the young entomologist, who will be amply repaid by the novelties which he may there obtain.

ACALYPHA. A genus of uninteresting exotic shrubs and annual herbs, belonging to the Linnæan class and order *Monœcia Monadelphia*, and to the natural order *Euphorbiaceæ*. This genus is arranged in four divisions, dependent on the character and situation of the flowers:—viz. 1, male and female flowers on the spike; 2, spikes of distinct sexes, the female ones terminal; 3, spikes of distinct sexes, the upper ones male; 4, flowers on separate plants, or diœcious. The known species are natives of North and South America and the Indies.

ACAMARCHIS (Lamaroux). *A. Dichotomous Polypidom*, of the first class and first order, whose polypi are found in shelly or non-irritable cells, which are united and alternate, terminated by one or two lateral points, with a vesicle at their opening. The vesicles are nearly globular; helmet-shaped, and placed on the borders of the cells, which they appear wholly to close. Various opinions have been formed with regard to their uses; but the most prevailing idea is, that they are ovaria, enclosing the germs of future individuals; for it has been observed, that these vesicular bodies are sometimes whole, in which case they are always found filled with small globular bodies; when these supposed ovaria are found opened by a transversal slit, the cells are empty.

The acamarchis resemble each other in form; they only differ by the number of teeth placed on the external side of the cells, and by the form of the latter, the border being either smooth or toothed; the upper membrane of the cells is frequently wanting, and in this state Ellis figured his first species.

The substance of the acamarchis is more horny than chalky; their colour a dull green or grey, changing by desiccation, or exposure to air and light, to a fawn colour, more or less bright. They attach themselves by numerous fibres to solid marine productions; and are found in the equatorial and temperate seas, seldom exceeding four inches in size.

ACANTHACEÆ. A natural family of plants, allied to the *Scrophularineæ* and *Bignoniaceæ*, belonging to the monopetalous division of *Dicotyledonous* vegetables. It contains about eighteen genera and 168 species, which are herbs or shrubs, chiefly inhabiting tropical regions. Their elastic dehiscent capsules, wingless seeds with hooked dissepiments, and imbricated flowers, are their distinguishing characters. Their leaves are opposite; inflorescence terminal or axillary; flowers in spikes, furnished with bracteas, and of a white, blue, yellow, scarlet, or purple colour. Calyx with four or five divisions, persistent; corolla monopetalous, and generally irregular; stamens two or four, in the latter case didynamous. The fruit is a capsule with two cells, and the seeds are supported on a filiform podosperm. Many of the species are mere weeds, but some of them are showy, and cultivated. Among the genera included under this family are *Acanthus*, *Thunbergia*, *Ruellia*, and *Justicia*. They are generally bitter and tonic, but their properties are scarcely known. The Acanthus (from the Greek word ἀκανθ, a spine) is the genus whence the name of the family is derived. The *Thunbergias* are climbing plants. *Justicia biflora* is used medicinally in Egypt; and the *Justicia pectoralis* boiled in sugar yields a sweet-scented syrup, considered in Jamaica to be a good stomachic. *Justicia paniculata*, called *Creyat* in India, is said by Ainslie to be the basis of the French *Drogue Amère*, famous as a tonic. The plants belonging to this family are propagated by seeds and cuttings.

ACANTHACEÆ; *Acanthus mollis*. *a*. Corolla opened, showing the stamens and pistil. *b*. Stamen. *c*. Pistil. *d*. Ripe seed vessel, covered with its calyx and bracte. *e*. Seed vessel burst previously to shedding its seeds. *f*. Seed opened, showing the radicle and plume.

ACANTHIA. A genus of insects, of the order *Hemoptera*, family *Acanthideæ* (Leach). The antennæ are filiform; labrum very prominent; rostrum straight and long; eyes very large and prominent; feet formed for walking and jumping.

This genus was established by Latreille, and has been adopted by later writers on the subject. To this genus belongs the *maculata;* black spotted with a pale colour; inhabits grassy banks.

ACANTHION. A genus of *Mammalia*, belonging to the order *Rodentia;* resembling the porcupines in many respects, so far as the very vague knowledge which we at present have of the genus extends. All that is at present known of the members of this supposed genus is one skull and one skeleton; the former from the island of Java, and the latter from some unknown place. The Javanese skull has the hinder part of the cranium depressed, the upper part elevated, the muzzle shorter, and the lower jaw shorter in proportion to the upper than the common porcupine which is known in Europe; but the lower jaw does not appear to be fully developed; and as the age of the specimen to which the skull belonged is not known, there may not be character enough in it to warrant the establishment of a genus.

ACANTHOPHIS (Spine-snake). A genus of poisonous serpents classed by baron Cuvier in the natural family of the vipers, but differing from them in many essential characters. They have a single row of plates on the under side of the tail, except sometimes near the extremity, where they are divided into two rows. The tail itself terminates in a small horny spine, which is not, however, peculiar to this genus, or even to poisonous serpents.

The characters of this genus, and even of most reptiles of all orders, are very imperfectly defined; and the species of this particular genus are very little known. The habits of poisonous serpents are in general so obscure, and they are so eagerly destroyed wherever they are found, that accurate accounts and unmutilated specimens are equally difficult to be procured The Acanthophii are cylindrical in their bodies, but tapering to the neck and the tail, and the length is considerable in proportion to the diameter, though the whole animal is of small size. The head is obtuse, covered in part with nine or ten scaly-guard-plates, and the plates round the eyes are partially raised or erected, so as to give a faint resemblance of a crest. The upper part of the body is covered by imbricated scales of a rhomboidal form, and the lower part particularly by simple plates as already mentioned. Besides the poison fangs, the jaws are armed each with a double row of small reserved teeth, to assist in the process of deglutition; and from the extent of the gape it may be at least supposed that the prey which they swallow is large in proportion to their size.

In New Holland, the only country where they have been ascertained to exist, they live in holes at the roots of trees or otherwise in concealment, and kill lizards and other small animals by poisoning. The New Holland species has been designated *Brownii*, after Brown the botanist. The body is coaly black, with some white on the upper lip. The tail is flattened, and its junction with the body is indicated by a diminution of the diameter. It is understood to be the most poisonous serpent in Australia; and as such, we may naturally suppose that exaggerated stories respecting it will be circulated. Another species, of which the native habit is not known, has been called *cerastinus*, from its resemblance to the crested viper, or horned viper of Egypt and Nubia. It is greyish above, and brownish-yellow on the under part, with black spots on the edges of the abdominal plates.

ACANTHOPTERYGII; *Spinous-finned Fishes.* A very numerous order of bony fishes, or of those that have their skeletons with the greatest proportion of earthy salts in their composition, and, therefore, the hardest that are met with among the fishes, though inferior in that respect to the bones of the mammalia and of birds. Their bones are, in the recent state, semi-transparent; they are more or less flexible; and they are without the ordinary cells and tubes in the internal joint, which are filled with marrow or oil in the bones of the mammalia, which answer the purposes of air-tubes in those of birds.

Their skeletons consist of the bones of the head, the spine, and its ribs and branches, and other small bones to which the fins are articulated, and which are either embedded in the muscles, as the shoulder-bones are in the mammalia, or articulated to the processes of the spine by elastic tendons. As the bones are most perfectly developed in the division under consideration, this seems the proper place to notice the difference between them and the bones of the other vertebrated animals. The head consists of a great number of bones, as many as 70 or 80 in some species; but they adhere to each other, and the sutures, or innumerable joinings, become obliterated. The bones of the head are altogether, in general, large in size; but the cavity for the brain is small. The teeth, except in a few species, are instruments of prehension rather than of mastication; they are, in general, very numerous and small, and the palate and partially the tongue are sometimes beset with them as well as the jaw. The head is united to the spinal column by a single tubercle, but the joint admits of little motion. There are never many of the vertebræ of the spinal columns *cervical* or tending to form a neck, and in most of the divisions there are none. The section of the vertebræ is sometimes circular, sometimes angular, and sometimes compressed laterally. The dorsal and caudal parts of the spine consist of a vast number of vertebræ, varying in different species and tapering towards the tail; the last one being always compressed laterally, and generally rounded, particularly where the small bones of the caudal fin are articulated.

The form of the vertebræ and the mode of their articulation, as compared with those of the other three orders of vertebrated animals, are worthy of notice, as indicating a greater simplicity of purpose than in that of the fishes. In them the spine is nothing more than a flexible rod. Each vertebra is a short cylinder or prism, according to the form of the section, terminating in a conical cup at each end. The interior of these cups is marked by concentric rings, said (but not proved) to indicate by their number the years that the fish has lived. The cylinders usually widen a little towards the mouths of the cups, which are slightly turned over or rounded. These cups are, in the living state, completely filled by cartilaginous fibres, softest toward the centre, where, from the form of the cups, they are also largest; they allow of free motion laterally, though not to any great extent in the single articulation; and the whole is at the same time highly elastic. The chief difference between the bony and cartilaginous fishes in this part of their structure is, that in the latter the column has little distinction of vertebræ, but is equally flexible through its whole length.

The dorsal part of the column, or that which answers to the spine of the trunk in the mammalia, is without spinous processes on the under side, but has them on the upper, and also obliquely and laterally, the ribs being articulated to the latter. All the bony fishes have ribs, sometimes forked, sometimes double, sometimes compressed, and sometimes in the shape of bristles; but in the cartilaginous fishes they are wanting. The caudal vertebræ have spinous processes both on the upper and the under side, which become smaller towards the termination, according to the shape of the fish. The clavicles support the sides of the body behind the gill-openings; and the pectoral fins may be considered as having some resemblance to the anterior extremities in the mammalia and the wings of birds; but the bones answering to the pelvis are very obscure.

The principal muscles in the bodies of these, and, indeed, of all fishes, are placed on the sides of the spine, and supported by the processes. They are formed in layers, placed in curves with their convexity toward the head. In this division they appear to contain more albumen and less gelatine than in the cartilaginous fishes, and even less than in those which have soft fins. The spinous fins have also more motion than those with soft rays, and especially than the fleshy ones; but so little is known of the habits of the animals that no very certain conclusion can be arrived at. The muscular action in swimming consists in bending them to each side alternately, accompanied by expansions of the rays of the caudal fin, resembling the opening of a fan; and in those fishes that have large scales, the posterior margins of these hold on upon the convex side when the body is bent, and thus tend to steady the action and prevent recoil.

The brain forms a smaller portion of the whole nervous mass than in the warm-blooded animals; and as the spinal column is in proportion to the body, not to the brain, we may naturally conclude that the energy of the senses, taken on the whole, is inferior to that of motion and digestion. They do not appear to feel much pain from wounds in the flesh; but in some species at least, there is a sense in the skin analogous to what we call touch. That the common trout (*salmo fario*) is pleased by tickling is so familiarly known that it has been made the foundation of a common saying on the effect of flattery :—

> " If you *tickle* the trout,
> You'll soon have him out;
> But handle him rough,
> And he's sure to be off."

The fishes of this division have no external ears, nor, indeed, have any of the osseous fishes ; and in the cartilaginous ones, the external orifices are exceedingly small. In the external ear there are, instead of the lamina and tympanum in the mammalia, certain little balls of porcelain lustre suspended by a nervous plexus ; but how the agitation of the water acts upon them so as to produce sound, or to what depth and in what particular manner sounds are produced in, or affect the water, is very little known, as we cannot bring it to the test of our own ears, and it is not possible to judge accurately of one sense from comparison with another ; that sounds have a considerable effect upon water is, however, clear, from the well-known fact that a cannonade tranquillises the waves for some distance round. Fishes have no voice when in the water ; and those sounds which some of them make when out of it are produced by convulsions of the gills and gill-openings, and not by the mouth. There is not, indeed, any organisation of the mouth or throat by which sound could be produced. Touch, indeed, appears to be their only means of communication with each other ; and that and sight are the senses upon which they chiefly depend. Authors have, indeed, written about the sense of smell in fishes, and pointed out how trouts of taste, differing from our epicures, prefer recent game to that which is high ; but the statements are not very philosophic in themselves, and they are opposed to all the facts of fishing with artificial bait, which no fish refuses if it is skilfully made and well-timed in the offer. The nervous enlargements at the origin of the olfactory nerves are, indeed, in some species, almost as large as the brain, but we know little of their action. Taste there can be little or none, from the readiness with which the same fish catches again and again at the same artificial bait ; and the whole internal surface of the mouth is of a description to which we would not, from the analogy of other animal structures, attribute much sensation of any kind. It is true that fishes are affected by impure water ; but the pain which it gives them appears to be chiefly, if not wholly, felt in the gills. In these cases they come to the surface, and pant and gasp there as if they were anxious wholly or partially to breathe the air. That may be seen in places where flax is much cultivated and prepared. When that plant is macerated, or steeped, in order to make the fibres part from the leaves, it communicates a most offensive intoxicating poison to the water ; and when the pits are allowed to empty themselves into streams, the fish are instantly affected and come to the surface,—come to more speedy and certain death indeed, for the most virulent part of the poison is the lurid scum which floats on the surface.

The eyes of fishes are much more perfectly formed than their other organs of sense, and we are much better acquainted with their action. They even observe a very minute object when the water is dark and the surface ruffled. But in a clear day river fishes can see a shadow passing along the water, and are alarmed by it. Their eyes are admirably formed both for protection and for readiness in the use. The surface is in general flat, and the common integument passes over the eye without any duplicature or eyelid, except in a few very peculiar species; and thus the most violent agitation of the water produces much less effect upon the eye of a fish than a gentle breeze does upon the human eye. Such an eye could not indeed exist exposed to the air, or to any drying element ; and hence in all eyes that are to be used in the air, there are either moveable eyelids, as in the mammalia, or nictitating membranes, as in birds, by the application of which the coat of the eye is kept moist and transparent. But the eye of a fish, from the nature of its element, and the adaptation of the structure to that element, is always ready ; and in all states of the water in which the muscular action of the fish can keep its place, the eye can see the smallest substance. Turbid water, or even rolling pebbles, can do little injury to an eye so flat. But in proportion as the external surface of the eye is flat, the crystalline lens is convex. It is, indeed, nearly a perfect sphere ; and thus the eye has great magnifying power ; although it appears to have considerable range of focal length. The eye of a fish is one of the most curious varieties of that most interesting of organs. See the article Eye.

As this division is considered by Cuvier as containing the most perfect fishes, or the types of the class, the mode of their respiration and the circulation to which it is necessary, must be regarded as that which is most perfectly expressive of an inhabitant of the waters—a breather by means of gills, the fibres of which play freely on that fluid. The structure and form of gills will be found explained in the article Fishes ; so that we have here only to remark that the heart of fishes is small and single. The auricle receives the blood from the body and sends it to the ventricle ; and that propels it through an artery which is finely ramified over the gills. From the gills it returns by veins, small at first, but meeting and emptying themselves into the aorta or large artery, which lies along the under side of the spine; and from that it is sent over the body, returning by veins to the auricle of the heart, but the veins are often much dilated, and the circulation in them very sluggish. The gills and the parts near the spine are the only ones that bleed copiously when wounded.

Such is a very short summary of the general structure of osseous fishes ; and we should now point out the characters of the order. Of these, however, there is hardly one constant, unless it be the spiny rays in the fins, and even that is not absolutely confined to the order, and is very variable in it. The particulars must therefore be reserved to the families or subdivisions, of which Cuvier's list is subjoined ; and the characters and subdivisions will be found noticed under the several titles.

Family I. *Percoideæ*, the perch family. They are numerous, and generally wholesome and rather palatable as food.

Family II. *Enaplœcephaleæ*, armed-headed fishes. These have the head variously furnished with spines, plates, or other appendages.

Family III. *Sciænidæ*.

Family IV. *Sparidæ*, the gilt-head family.

Family V. *Mænidæ*.

Family VI. *Squameptereæ*, scale-finned fishes.

Family VII. *Scomberidæ*, the mackerel family.

Family VIII. *Tænioidæ*, the riband-fish family.

Family IX. *Theucidæ*, the lancet fish family.

Family X. *Pharyngolabyrynthidæ*, labyrinth palated fishes.

Family XI. *Mugilidæ*, the mullet family.

Family XII. *Gobioidæ*, the goby or sea gudgeon family.

Family XIII. *Carpaptereæ*, fishes bearing the pectoral fins attached to an elongated stem like a wrist.

Family XIV. *Labroidæ*, the wrasse family.

Family XV. *Fistulidæ*, the pipe fish family.

ACANTHOSCELIS. A genus of Insects, of the order *Coleoptera*, family *Scarabidæ*. The antennæ are filiform (thread shaped); the first joint very large, the others considerably less, but gradually increasing near the extremity: superior lip very short, and furnished with three teeth: mandibles large, projecting, and toothed internally: labial palpi, with the last joint nearly cylindrical: mentum or chin, articulated and strongly trilobated. Thorax convex, transverse, and almost square. Body short, and convex: elytra short and very convex: anterior legs very strongly palmated: posterior legs short, thick, and covered with spines: trochanters almost as large as the posterior legs.

The Count De Jean observes, that this new genus was formed by Latreille for the *Scarites ruficornis* of Fabricius, and is indicated in his *Familles naturelles du Règne Animal*. This species appears a good genus, as it is easily distinguished from *Scarites* by its short, thick, and very convex form, and the above character.

ACANTHOCINUS (Megerle). A genus of insects of the order *Coleoptera*, family *Cerambycidæ*. Antennæ of the male more than four times the length of the body, those of the female above twice its length; basal joint somewhat robust, second short, third longer than the fourth; the remainder nearly equal in the female, but gradually lengthening in the male to the terminal joint, which is very long and slender: palpi short, the terminal joint fusiform, acute: body rather depressed: thorax transverse, having a spine on each side: legs robust.

Acanthocinus.

Acan. ædilis. Body short and depressed; the colour brownish, and the surface more or less thickly covered with ash-coloured pubescence; head punctured, and having a shallow groove on the forehead; antennæ of the male four or five times the length of the body, those of the female twice its length; the base of the joints brownish, and covered with cinereous pubescence, the apex black; thorax thickly and ruggedly punctured, with a strong spine on each side, and four tufts of yellowish pile placed across the disk before the middle; elytra, with the apex of each rounded, the upper surface unequal, pale brown, with cinereous pubescence and a few scattered tufts of black pile; the base punctate, the apex nearly smooth, having an oblique irregular fuscous fascia anteriorly, and another, somewhat abbreviated, behind; under side ferruginous, clothed with whitish glossy pubescence: legs brownish, pubescent, the tarsi somewhat dusky: length of the body from seven to nine lines.

The abdomen of the male has the anal segment short and emarginate, but in the female it is produced into a long conical tube of a black colour.

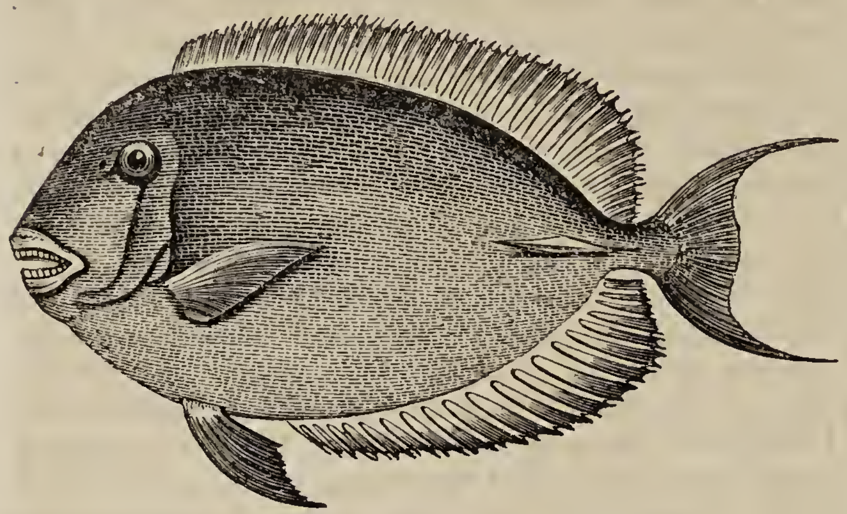
This is a very local insect, but has been found rather plentiful in Worcestershire, and many of the London cabinets have been supplied through the liberality of Mr. Raddon, the eminent engraver; specimens have also occurred in the neighbourhood of Kirkaldy, in Scotland, and are preserved in the cabinet of Sir P. Walker.

Acan. speculifer. Greyish white, with four spines on the elytra and two on the thorax, forming a coronet of spines, in the male, with a burnished spot like talc, on the disk of each elytron. It is figured in the previous column. Length of the body one inch.

This beautifully-formed and extensive genus of insects are found on timber in their adult state, and their larvæ feed on the decayed wood: the feet of these are extremely small, the body soft, and of a whitish colour; the anterior part larger than the posterior, the head scaly, and furnished with powerful jaws: they are very destructive, perforating the interior of the largest trees. Most of the species of this family produce a singular noise, by rubbing the hinder part of the thorax against the base of the abdomen. Lister calls this a querulous sound, though it bears a nearer resemblance to the rubbing together the milled edges of two pieces of coin, and we are not aware that it is confined to either sex. It has been asserted by some authors that some of the species are nocturnal.

In the exserted oviduct of the females of the timber-feeding larvæ, a most beautiful provision of the Creator is shown, the animal being enabled to insert its eggs into the crevices of the bark of trees; thus securing them from the effects of the weather, and protecting them from birds; for as soon as the caterpillar escapes from the egg, it begins to enter the wood, and tends greatly to assist in the destruction of those immense trees which, if left to a casual decay, would prevent the growth of others in those extensive forests of tropical climes, where these wood-feeding, elegant, and singular insects abound. In very few tribes in this portion of the insect creation do we find more to admire or charm the eye,—their beauty of form, variety of colour, length of antennæ, and the clothing with which they are invested, seem to claim the attention of man.

ACANTHURUS. (Lancet Fish). A genus of fishes, belonging to the ninth family of Cuvier's order of fishes, with spinous fins. The characters are, the body and tail compressed; the mouth rather small, and without any teeth on the palate, but furnished with a single row of strong cutting teeth, with jagged points in each jaw; and they have but one dorsal fin, and on each side of the tail there is one or more very sharp moveable spines, with which the fish inflicts severe and deep wounds, if incautiously handled. It is from the depth of the wounds inflicted by these instruments, and their tendency to bleed, that the common name of lancet fish is given; and the generic name "spine tail" is founded on the same. There are about six known species, all inhabitants of the warmer seas, and most, at least, found both in the Atlantic and the other tropical oceans. The particular use of these formidable spines in their economy is not well known; probably they are employed as defensive weapons against larger fishes. The common lancet fish is found chiefly in the West Indian seas, where its flesh is much relished, as being both wholesome and nutritious. The characters, and even the names, of the species are a little confused. Some have the dorsal fin much produced; others have the spines on the tail partially concealed anteriorly by a tuft of bristles; and others again have the teeth so deeply grooved on the one side that their cutting edges resemble the teeth of a comb. They are altogether a very curious genera of fishes, peculiar to the tropical or warm seas, and very characteristic of them, which are the only portions of the sea where animals, whether fishes or reptiles, are understood to graze the vegetable productions of the deep.



Acanthurus nigricans.

The above figure will give some idea of the shape of these singular tenants of the deep, which, notwithstanding their trenchant teeth, and the very formidable weapons with which their tails are armed, cannot be classed among predacious fishes. Their principal food, at least that of most of the species, is not even the small animals of the sea, but marine plants—the more succulent kinds of sea-weed, which grow so abundantly in the shallows of the tropical seas. They thus bear to the rest of the finny tribes a relation somewhat similar to that which the herbaceous mammalia bear to the rest of that class. Not that they ruminate; but their intestinal canals are long, and very much convoluted, as is the case in those of the mammalia which live upon vegetable food; and it is not a little singular that the defensive weapons (for it does not appear that they use the spines or lancets for the purpose of attack) should be placed on nearly the same part of their bodies. In the horse and the ass, and still more remarkably in the giraffe and the kangaroo, the defence is in the heels; and so powerful is the kick in the giraffe, that if it take effect it can fracture the skull of the lion; and the spines upon the acanthuri are so situated that they deliver their blow with the whole muscular power of the fish; and thus render it rather a serious matter for the sharks and other voracious fishes to attack them in the rear.

There is something analogous in another class of the inhabitants of the sea—the whales. The common Greenland whale does not feed upon vegetable matter, but its food consists of such small substances, and is caught by so curious an apparatus—the plates of *baleen*, or whalebone and their fringes, that the animal cannot either attack or defend itself from its enemies by the mouth, or in any way with the forepart of the body. But the blow which the common whale can give with its tail is far more powerful than that even of the largest of the toothed whales; and may be said to bear nearly the same proportion to their bite that the kick of the kangaroo bears to the bite of a dog, or the kick of the giraffe to the bite of a lion.

In these different situations of their weapons, which may be traced through all the classes of animated beings, we can discover a very striking proof of that beautiful adaptation, equally free from redundancy and defect, which makes the study of nature so useful to us in the economy of our artificial contrivances. All the predacious animals have their weapons in front, and conducive to the purposes of feeding; and the more powerful they are in preying, they have their hinder parts weaker than the anterior ones—that is to say, weaker in proportion. Not only so, but their eyes are turned more to the front, and infenced and shaded by the superior parts of the orbits, so that their most effective action is in guiding the animals to their prey. The non-predatory ones, on the other hand, have in general the hinder parts stronger in proportion, so that they may defend the animals while they are feeding; and their eyes stand out, so that in very many instances they can keep guard in the rear, without turning the head. In the horse, the kangaroo, and the giraffe, these adaptations are very striking, and there is an approach to them in the acanthuri. The form of the body, deep at the middle, but compressed laterally, enables it to take a strong hold on the water as a fulcrum; while the comparatively slender portion, near the root of the caudal fin, to which the lancets are attached can move with great rapidity, and the weapons cut right and left with great effect. Their eyes, too, stand out; so that the fish can see its enemy and take aim, instead of striking at random.

ACANTHUS (Bear's Breech). A family of deciduous herbaceous plants, containing seven species, chiefly natives of the south of Europe. They belong to the Linnæan class and order, *Didynamia Angiospermia;* Natural order, *Acanthaceæ.* Generic character: calyx of four unequal divisions, the two outside ones being smallest; the corona is of one lip; stamens four, two being longer than the others; anthers unilocular, and bearded; capsuli oval, of two places, each containing two seeds. The leaves of the A. mollis are remarkably graceful, and are said to have supplied Callimachus with patterns for the foliage of the capital of the Corinthian column. The Arabs have a species, the leaves of which they eat as a salad.

ACARI (Cuvier, Leach). A class of the invertebrate animals established by the late Baron Cuvier of the great type *annulata*, or *annulosa* of Mac Leay, the characters of which are as follows: Tracheæ for respiration; body formed of but one segment: mouth rostriform, in some furnished with maxillæ and mandibles; legs six or eight: the following are the sections and families of these so little understood and less known animals, as but very few of the exotic species have yet reached this country:

Section I. Legs formed for walking.

A. Mouth with mandibles.

Family I. *Trombidiadæ*: Palpi porrect, and furnished at their extremities with a moveable appendage.

Eyes two, placed on a pillar. Body apparently divided into two parts by a transverse line; the anterior division bearing the eyes, mouth, and four anterior legs.

Genus *Trombidium, Ocypete.*

Eyes sessile. Body not divided by a transverse line, palpi with the under part of their last joint furnished with a moveable appendage.

Genus *Erythræus.*

Family II. *Gammasidæ*: Palpi porrect, and simple.

Genus, *Gammasus.*

Family III. *Acaridæ*: Mouth furnished with mandibles, palpi simple, very short, not porrected.

Genera: *Oribita, Notaspis, Ocarus.*

B. Mouth furnished with a rostrum.

Family IV. *Ixodiadæ*: Eyes obscure or concealed.

Palpi and rostrum exserted.

Genus, *Ixodes.*

Palpi and rostrum hidden.

Genus, *Uropoda.*

Family V. Eyes distinct.

Palpi distinct.

Genera, *Cheyletus, Smaris, Bedello.*

Palpi concealed.

Genus, *Sarcoptes.*

Section II. Legs formed for swimming.

Family VI. *Eylaidæ*: Mouth with mandibles.

Genus, *Eylais.*

Family VII. *Hydrachnidæ*: Mouth without mandibles.

Genera, *Hydrachna, Limnochares.*

ACARNA (Linnæus). A genus of herbaceous plants, natives of the south of Europe, belonging to the Linnæan class and order *Syngenesia Æqualis.* Natural order, *Compositæ.* There are only two species, viz. *A. gummifera,* gum-bearing, which is a perennial; and *A. cancellata,* latticed, which is an annual.

ACARUS (Linnæus). A genus of the Annulosa, in the class *Acari,* and family *Acaridæ* (Leach). Body soft; mouth naked, and furnished with mandibles, or jaws; palpi very short, simple, and not porrected: tarsi with a pedunculated vesicle at their extremities.

Sp. 1. *A. domesticus.* White, with two brown spots; body ovate, the middle coarctate, with very long hairs: legs equal. It inhabits houses, living in cheese, flour and meal that have been long kept.

To the naked eye, these minute creatures, the *cheese mites,* appear little more than moving particles of dust; but on the application of the microscope they are found to be perfect animals, performing all the regular functions of life. The head is small in proportion to the rest of the body. Their legs are furnished at the extremities with little claws, by which they are enabled to lay firm hold of the substances they inhabit. The body is furnished with long hairs, which enables them to creep through crevices that would not otherwise admit them.

The females, which are easily distinguished from the males, are oviparous. The eggs are so minute that, on a comparative calculation, it appears that ninety millions of them would not fill the shell of a pigeon's egg. These are hatched, in warm weather, in about twelve days; but during the winter season the time of hatching is much longer. When the young first come forth they are extremely minute; and before they attain their full size they cast their skin several times.

The mites are very quick-sighted; and when once they have been touched with a pin, it is easy to perceive a great degree of cunning exerted to avoid a second touch. They are extremely voracious animals, and are often observed even to devour each other; and so very tenacious are they of life, that they have been kept alive many months between two concave glasses, by which they were applied to a microscope. Leeuwenhoeck placed a female mite on the point of a pin for examination; she remained there ten days, and during the time laid two eggs, which for want of food were devoured.

Acarus Scabiei. The acarus that inhabits the vesicles of the itch.

These insects have also given name to a disease called *Acariasis,* many curious instances of which are given by medical writers; and Mouffet relates the following instance of lady Penruddock, concerning whom he expressly tells us, that acari in every part of her body—her head, eyes, nose, lips, gums, the soles of her feet, &c.—tormented her day and night, till, in spite of every remedy, all the flesh of her body being consumed, she was at length relieved by death from this terrible state of suffering. Mouffet attributes her disease to the acarus scabiei above alluded to; but from the symptoms and fatal result, it seems to have been a different and much more terrific animal. He supposes, in this instance, the insect to have been generated by drinking goat's milk too copiously. This, if correct, would lead to a conjecture that it might have been the *A. lactis* of Linnæus.

Man is not the only animal subjected to the attacks of these little tormentors; from the elephant to the smallest quadruped, from the majestic eagle to the delicate humming bird, from the leviathan of the deep to the smallest fish, all in their turns are annoyed by these minute parasites; and the following well authenticated facts will prove that insects also suffer from them. The common dung beetles may often be met with in the spring of the year, covered on the underside of the body with small mites, which look as if they were engaged in suction—they are often so numerous that no part is uncovered, they also attack other beetles, especially those of the harpalidæ and histipidiæ. They are easily disturbed, run with great swiftness, and may often be seen in hot beds, prowling in search of the stercorarious beetles. But the most remarkable insect of this kind is the *Urapoda vegetans;* it derives its nutriment from the insects it assails, not by its mouth, but by means of a long anal pedicle, by which it is attached to them. De Geer found these in such numbers upon a species of *leptura,* that its whole body was almost covered with them; they hung from the legs and antennæ in bunches, and gave the animal a most hideous and disgusting appearance. Under this load of vermin it could scarcely walk or move, and all its efforts to get rid of them were in vain: many were attached to its body and to each other by their anal pedicles, but others had cast them off, and were walking about. When put into a glass with earth, they began to abandon their prey, so that in a few days it was quite free from its plague. He found that these parasites lived long in alcohol.

The author of the present article can vouch for the following anecdote, communicated to him by Mr. Daniel Bidder, an indefatigable, well-informed, and old collector of insects, as well as a close observer of their proceedings. Many years since when collecting in the new forest of Hampshire, he sat down on a bank to take some refreshment, the sun was obscured by clouds, when presently he saw a specimen of the *apis terrestris,* or humble bee, alight near him, and begin to scratch, and make a disturbance; there being no sun the ants had retired, but it was an ants' nest on which it had taken its station; the ants immediately came out to attack it, and observing the insect covered with acari, soon destroyed or carried them off; when the bee, thus relieved from its enemies, carefully cleansed its body and wings with its feet, and then took flight again, evidently much relieved. There is nothing which more strikingly displays the wisdom and power of the Creator than the faculties with which the small species of animated nature are endowed. In our ordinary estimates we are accustomed to associate grandeur and power with magnitude, and to suppose that the productions of nature become insignificant in proportion as they become small. But, when we go to nature itself, and compare the size of the creature with the functions which it performs, we discover that mere material size is an absolute clog upon the living energy, and that the smaller animals are, in proportion, much more active than the greater.

ACASTA. A genus constituted by Dr. Leach, from the Linnæan genus Balanus. These shells are found enveloped in sponge, and never affixed to hard bodies; the valves are but slightly connected together, particularly those at the lower part; the exterior form is oval subconical, formed of six lateral unequal valves with an orbicular lamina, internally concave (resembling a patella), forming the base; the operculum with four pieces or valves, the exterior of the base being conical or convex, prevents the shell from standing by itself in an erect position, when detached from the substance which envelopes it. There are three species known. Lamarck and modern naturalists continue to place this genus with the Balani, from which there does not appear sufficient reason to separate it.

ACCENTOR. A genus of birds belonging to the insectivorous order, or rather of that intermediate character which connects the insectivorous with the seed-eating birds, as the hedge-accentor, hedge-chanter, commonly but incorrectly styled the "hedge-sparrow," the species with which we are most familiar as a common resident British bird; it feeds upon insects in the summer, and upon seeds and other vegetable matters in the winter.

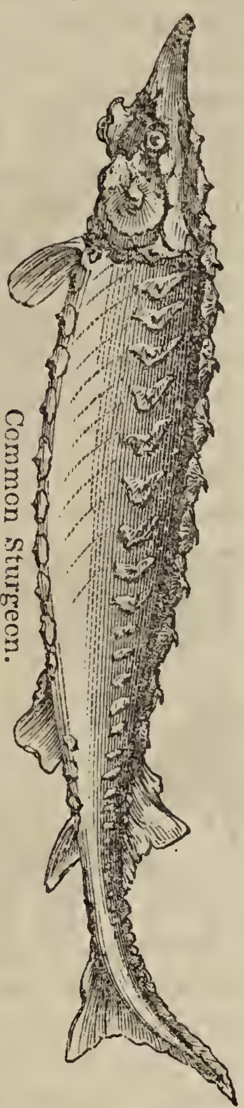
The characters of the genus are: the bill slender and of mean length, conical in its form, much pointed, the *tomia* or cutting edges compressed, and the upper mandible slightly notched towards the tip; the nostrils basal, pierced in a large membrane, and naked; the legs stout, with three toes forwards and one behind, the inner toe free, but the middle and outer ones united at their bases. The wings are wedge-shaped, the first quill being very short, the second half the length of the third, and the third the longest in the wing. They run fleetly upon the ground, and fly with boundings or jerks. They are, as far as is understood, all song birds, with sweet notes, but not very much varied or powerful. There are several species.

A. modularis, the hedge-chanter, is the only British species; it is resident, though it migrates within the country with the seasons, being found in the fields and on the edges of the moors in summer, and resorting to the neighbourhood of farm-houses in the winter, though not in large flocks like the seed-eating birds, properly so called. They hop about in farm-yards and near houses in the winter; but in February, or even in January, if the weather is mild, the male commences his song, which is sweet and plaintive, and always delivered from the perch; for when the bird flies, he merely utters that querulous "tit," which has procured him the name of titling. Soon after the song commences, the birds pair, retire to the fields, copses, or moors, and commence the labour of nest building. The nest is always built in the thick cover of a hedge or bush, constructed of moss and wool, and lined with hair. The eggs are four or five in number, of a clear greenish blue without any markings. The nest is usually completed in March, at least in the southern parts of Britain; but there are probably two broods in the year, as the eggs of the cuckoo are said to be found in the nests of these birds, and the hatching of the first brood must be in progress before the cuckoo arrives. The hedge chanter is an inoffensive little bird, and one of sober appearance; and there is hardly any difference in the plumage of the sexes. The length is about six inches, the extent of the wings about eight, and the weight about six drams. The size is nearly the same as that of the common red-breast, but it is more slender in proportion to its length, does not seem so robust, and has not the pert and pugnacious air of the red-breast. The bill is dusky, and the tarsi and toes yellowish brown. Top of the head grey with brown streaks, throat and breast bluish grey, upper part yellowish brown with the centres of the feathers purplish brown, belly greyish white, and some white on the middle coverts of the wings and the lower ones of the tail.

A. montanellus, the hill-chanter, is a bird of the hilly parts of south-eastern Europe and central Asia; and, like the former, does not migrate far, as it is not found so far south as Naples, even in the winter. During the greater part of the year it inhabits the woods on the hills and dales of the mountains, forming its nest nearly in the same manner as the British species; and, like that, descending to the plains and inhabited places when the severe weather sets in; and it serenades the people with its soft and plaintive song before it departs. The most remarkable external distinction between the two is that the hill species has the cheeks black.

This genus has been confounded with the warblers, and also sometimes with the wagtails; but they are distinct both in their generic characters and their habits.

ACCIPENSER (Sturgeon). A genus of fishes belonging to Cuvier's seventh order, or first order of *Chondropterygii*—the order *Sturionidæ*; that is, cartilaginous fishes, with two gills, and having a gill-lid to the opening, but no gill-flap. Their bodies are long, and not unlike those of the sharks in shape, but they are very different in their covering. Their skins are beset with longitudinal rows of osseous plates, in some instances bearing a considerable resemblance to the shells of limpets, and in others keeled or produced into spines. Their heads are also armed with bony plates; their muzzles more or less produced, and their mouths placed under the muzzle, of small dimensions compared with the size of the animals, and without any teeth. The upper maxillary bones are united to those of the cranium, which form one piece without distinct sutures, as is the case with all the cartilaginous fishes; but the under jaw can be protruded, or projected farther forward than in the sharks, there being three articulations in the intermaxillary bones of the sturgeons, while the under-jaw of the sharks is articulated by a single tubercle. This particular form of articulation, however, enables the jaws of the shark to act with much more power than those of the sturgeons or indeed of almost any other fish, as besides the motion of closing they have a lateral grinding one, and also separate motions of the teeth. The lower jaw of the sturgeon is furnished with a sort of beard of soft fibres. The eyes and nostrils are placed laterally and wide from each other. There are no external ears, but the labyrinth of the ear is much better formed within the bones of the cranium than in the bony fishes; though there is not an external opening of the ear, as in the cartilaginous fishes that have the gills fixed. There is indeed a small hole behind the temple, but it does not lead to the labyrinth of the ear. The dorsal fin is placed behind the ventrals, and the anal fin under it. The caudal fin surrounds the extremity of the tail, but is not much produced, except in a lobe on the under part. The air-bag is very large, and communicates with the gullet by an aperture of considerable magnitude.



Common Sturgeon.

Fishes of this genus are mostly large, and inhabit the great rivers and shores of the temperate latitudes rather than either the torrid or the cold. In Britain they are rare, and they are not very common on the west coast of Europe, or in the rivers which empty themselves into the seas there. In the east of Europe and west of Asia they are much more numerous. The flesh of some of them is highly prized, and more resembles meat than fish, both in texture and in flavour; that of others is unpleasant, and in some instances unwholesome. The fish, and especially their roes, which in a prepared state are called *caviar*, form an important article in eastern commerce, the more so that the species which are most esteemed are found in the more northerly rivers.

The whole body of the sturgeon is very gelatinous; and the air-bag, when freed from fat and oil, is the purest gelatine and therefore the best jelly or glue that is obtained in the animal kingdom. It forms the genuine *isinglass* of commerce. The same substance may, however, be obtained from the fins and other refuse, and indeed from the refuse of any fish; and there is as much of that description of matter not only wasted, but wasted in such a way as to be very offensive, at our fishing villages, and many of our fish-markets, as would supply all the arts abundantly with that very useful, and in the culinary art very wholesome article. There are four European species.

1. *The great sturgeon* (*Accipenser huso*), common in the Danube, the Po, and some other large rivers of south-eastern Europe, and occasionally found in the Atlantic. It has the skin smooth, the plates flattened, and the filaments that form the head short. It is a very large fish, twelve to fifteen feet in length, and weighing from two to three hundred weight. Cuvier mentions that specimens nearly 3000 pounds in weight have been seen. Indeed, as these cartilaginous fishes do not appear ever to "get old," or to cease from growing, it is not possible to fix the maximum dimensions which they shall not exceed. This species is neither palatable nor wholesome.

2. *The Scherg sturgeon* (*Accipenser pelops*) is much smaller, being seldom above four feet in length. It has the osseous plates more produced into spines than any of the others, and the muzzle longer in proportion and more slender. It is very abundant in many of the Russian and German rivers, but its flesh is little esteemed or sought after.

3. *The little sturgeon* (*Accipenser ruthenus*) is the smallest European species, seldom measuring more than two feet in length; but it is the most highly prized of the order, and both the flesh and the roe are accounted delicate food; the plates on it are very numerous, they are keeled on the sides, but flat toward the belly.

4. *The common sturgeon* (*Accipenser sturio*) grows to the length of six or seven feet. The plates are arranged in five longitudinal rows upon each side, very firm in their structure, and sharp and spiny at their points; the muzzle also is pointed, and the filaments of the head are longer than in any of the other European species. This is the species which is best known in domestic economy.

Several species have been mentioned as inhabiting the larger rivers of North America; but our acquaintance with them is still very incomplete. For an account of these fishes as articles of commerce, as well as for any further light that may, in the interim, be thrown upon their history, we must refer to the article Sturgeon.

ACCIPITRES (Takers by Force). Rapacious Birds, or Birds of Prey. A numerous and highly interesting order of birds, displaying the peculiar characters of the class in the very highest perfection, and forming one of the grandest features of animated nature. Their general habit is to feed upon warm-blooded animals, which they overtake by speed of flight and kill by strength; and some of the most bold and daring of them subsist wholly upon this species of food, and will suffer the greatest extreme of hunger before they partake of any other. Some, however, feed more upon carrion and offal; others upon fish, reptiles; and some occasionally upon insects. The characters and the haunts of the different species vary with the nature of their food, and the manner in which that food is obtained. But though they are thus different, and their appearance and conduct strike us as being in some species sublime, and in others the reverse, they are all so admirably adapted to their peculiar modes of life, that it is impossible to say which affords the finest instance of that wonderful coincidence between purpose to be obtained and means of obtaining that purpose, of which creation is so very full, and the contemplation of which is calculated to inspire us with so much veneration for the great Author of nature, and at the same time to afford us models in all our useful arts, which our utmost skill can never excel.

In this order of birds we have the perfect model of strength combined with swiftness; and also of power and energy, when in action, united with calmness and repose when that action ceases to be necessary. The birds are preyers, but they have their appointed prey; and though, of course, they have no design in the matter, they exist for the preservation of the very races upon the surplus of which they feed. The powers of life are everywhere greater than the average need there is for them; and throughout the whole of the organic world, whether vegetable or animal, the surplus of one race feeds another, so that the season provides for itself. When the heat of the sun acts, if the surface be not mere dry sand, the powers both of animal and vegetable life must obey it; hence, in those places the number of mountain birds, mountain hares, and other mountain animals, which are produced in the warm seasons, could not be supported in the cold; and thus, if it were not that the mountain eagle and the mountain hawk thin their numbers, they would be thinned by starvation.

But a thinning of the numbers by starvation would be a very unwholesome thinning. It would come, not like the judicious pruning of the cultivator, who removes a part in order to benefit that which survives, but like the blight which falls upon and withers all indiscriminately, so that the part which remains is of little value. Hence, the provisions which nature makes against redundancy and consequent want and suffering, all come into operation before that which they correct has done mischief. There is one set of regulations (for the predatory animals are, in a natural point of view, regulators and not destroyers) which apply to all indiscriminately, whether disease has begun or not, and to that class the bolder of the rapacious birds may be considered as belonging. There are others which clear off the weakly, for whom there is, in the course of nature, little prospect of recovery; and to that class some of the rapacious birds, and the ravens and others of the omnivorous order, may be assigned. There are others still, which do not attack, but clear the earth of the remains after casualty has done its work. These do not kill, but they, in general, feed ravenously; and they are so furnished that they can scent, or otherwise discern, their peculiar food from afar, and can range far and wide over the country in quest of it. It will be seen that one division of the birds of prey have this character.

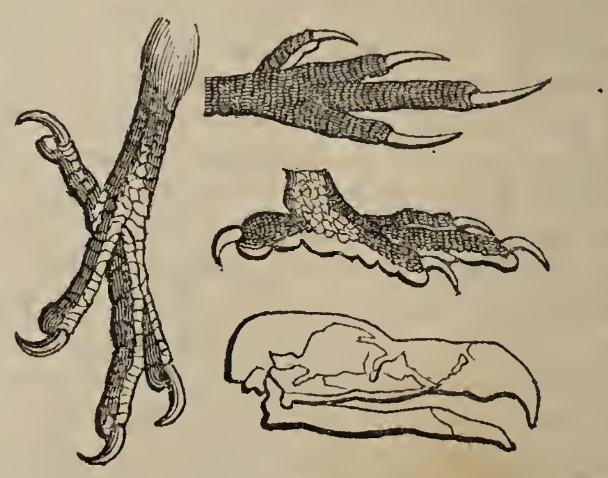
These remarks are general, and apply to rapacious animals of all kinds, as well as to the order Accipitres among birds; and as all animals prey upon organised substances of some kind or other, they might, by the same fastidious spirit of ignorance, be in turn accused of similar cruelty. The lamb nibbles innumerable plants, which, if let alone, would bear seeds, and exhaust the soil till the grass disappeared, and it could bear only sorrel, or moss, or some equally unseemly and unprofitable crop; and the warblers consume myriads of caterpillars, which, but for them, would not leave one green leaf in the grove.

Such are the uses, in wild nature, of the Accipitres; and it is to wild nature only that the more powerful ones belong. When man claims the produce of the flock and the field, as the reward of his care and culture, they retire, and leave him to enjoy the fruits of his labour. In their characters they are well defined; and when one of the order is known, there is little danger of mistaking any of the others; for their form, their air, their flight, and all their appearances and actions harmonise.

Their general characters are:—the bill of moderate length, strongly made, hard, and firm in its texture, sharp in the *tomia*, or cutting edges, very much hooked at the lip, and generally with a tooth in the one mandible and a notch in the other. The feet have four toes, three forward and one behind, but the outer ones are sometimes reversible; the whole armed with very strong, sharp, and crooked claws (usually called talons), those on the hinder toe and interior front toe being generally the largest, and acting most immediately against each other. The tarsi, or lower portions of the legs (of the feet rather), are generally short, very tendinous, and have strong bones; but they are firm rather than large. The bodies are compact, and the feathers generally strong and not easily ruffled. The eyes are keen and piercing, the scent in some of the species very acute, the motion often rapid, and the general expression that of great energy and equally great endurance. There are two tribes very distinct in most of their habits: those that prey by day, and those that prey by night or in the twilight.

TRIBE I. DIURNAL BIRDS OF PREY.—These have the plumage firm and close, the flight rapid, and the whole air and expression energetic. The base of the beak is covered by a naked membrane called a cere, in which the nostrils are pierced. Their eyes are placed in the centre of the head, so that they command nearly the whole horizon. Their sternum or breast bone is very strong, and has a deep keel along the centre, to give motion to the muscles that move the powerful wings. The *furca*, or "merry-thought," the bone which keeps the shoulder-bones apart, is a strong semicircular arch; the bones of their wings are very fully developed, and in some of the more perfect the fingers can be distinctly traced in the terminal bone. All their bones, indeed, are remarkable for firmness and strength; and the hollow ones are powerfully fortified by cross pieces at all parts where they have to bear any great strain. Their wings vary in form according to the habit, but the quills or flying feathers are very strong and stiff, as are also the tail feathers, which are in general capable of being spread out like a fan; and they and the quills are well supported by casements. The whole structure of the bird is a model of the union of the greatest possible strength with the least possible weight. There are two very distinct families, *vultures* and *falcons*, the latter admitting of convenient subdivision into septs or sections.

Vultures (*Vultur*). These birds chiefly inhabit the warmer countries, where, from the violent alternations



of drought and rain, other animals are subject to many casualties. They are found chiefly in wild and mountainous places; but they range far and wide, feeding chiefly upon carrion, and not often attacking living animals. They can endure hunger long, but they feed greedily, even to stupefaction and incapability either of flight or defence. They have a very keen sight. They are uncouth and ragged in their forms, and, in proportion to their strength, cowardly in their dispositions.

Their more obvious characters are—the beak straight at the base, hooked at the tip; part of the head and neck bare of feathers, the eyes close to the head. The tarsi and talons rather feeble, the former covered with a network of small scales; the wings very long, and seldom quite closed when the birds are on the ground. They, however, vary a good deal in their habits. Though cowardly in their nature, and easily put to flight, even by much weaker birds, when these offer to attack them, the vultures are daring enough in the search of their food. They will not only hover around carnivorous mammalia, and attempt to share the carrion or other prey upon which these are feeding; but they approach human habitations, encampments, and even cities, pouncing readily upon animal substances, but preferring those that are in a putrid state. They are the least predaceous birds of the order; and some of them, in a few of their characters, bear a slight resemblance to the poultry tribes. They build their nests generally in rocks, and do not perch on trees. See Vulture.

The Falcon tribe (*Falconidæ*). This family, as has been hinted, admits of convenient subdivision; but the general characters of the whole are striking and well defined. The head and neck are feathered; the eye is shaded by a projection above, which has something of the appearance of an eyebrow, and gives great keenness, as well as intelligence of expression, to the eye, which, in itself, is very bright. The cere of the bill is generally coloured, and the basal portion of it beset with short strong hairs. Both mandibles are, in general, hooked throughout their whole length. They are very strong; the upper one pointed at the tip; the under one obliquely rounded, and the cutting edges are furnished with a tooth, or notch, more or less perfect. The whole instrument indicates a capacity of rending substances in a more recent and consistent state than the carrion beak of the vultures. The nostrils are pierced in the cere, open, and rounded or oval in their outline.

The tarsi are stout and of moderate length, and covered with feathers or with scales; the outer toe is often united to the middle one, with a membrane at its base; but the inner toe is quite free. The claws are very pointed and sharp, capable of much motion when the bird is excited; but retractile, although not into sheaths, when it is in a state of repose. The retraction, which is performed by an elastic tendon, elevates the point of the claw above the plane of the pad on the tip of the toe, so that the claws are not injured when the birds rest upon sharp points. The claws are not used in feeding.

In many of the species, there is considerable difference between the plumage of the young and mature birds, which has sometimes led to the multiplying of one species into two or more. The same mistake has, also, sometimes arisen from the difference between the male and the female. The female is by far the more powerful bird, often a third heavier than the male, and strong, bold, and fierce in proportion. The principal differences in the plumage are, the young have the colours more broken and mottled than the mature birds, have more the tint of the female than that of the male, and the females are more inclined to brown than the males.

They are very strong, and can carry an animal nearly as heavy as themselves through the air for many miles. They prefer the prey which they kill, which are most of them warm-blooded animals, birds, or the smaller quadrupeds; but some of them also eat reptiles, fishes, and even beetles. They are not cruel birds, and do not torture their prey like the vultures. They are quiet birds, and seldom come abroad except to seek their food. They nestle in lofty and inaccessible places, and more rarely in trees or on the ground.

They eject by the mouth the bones and other exuvia of their food which resist the process of digestion; and the ejectment is in the form of balls, which are called "castings," or "quids." They inhabit most parts of the world; but the larger species are found only in wild places, and the more bold and daring ones in the cold latitudes rather than in the warm or even the temperate.

The more obvious subdivisions are, Eagles, Harriers, Hawks, Kites, and Buzzards, under which titles notices of the more remarkable species will be found.

Tribe II. Nocturnal Birds of Prey.—Though the habit of these is predaceous as well as that of the former, they are very different both in their characters and the times of their appearance. The diurnal birds of prey have their plumage compact and firm, and when they dart through the air they ring as though they were clad in armour; and few of them will seize their prey except openly in the free air and the light; and the most daring ones assail it only when on the wing. The nocturnal species, on the other hand, are birds of twilight and gloom; they reside during the day in holes or the thick coverts of trees; and most of them, when they resolve to fly while the sun shines, appear confused and lose their way. Their plumage is "fined off" at its terminations into a very soft and delicate fringe, which enables them to glide noiseless through the air, and even among the leaves and sprays of the thick forests, of which some of them are inhabitants. Their noises even are hollow and dolorous, and have not the stirring and ear-piercing effect of the chirrup of the diurnal accipitres; and hence they have obtained the common name of Owls, or "howlers."

Their most general characters are these: the head large and round, having a slight resemblance to that of a cat; their eyes very large, directed forwards, capable of great dilatation in the pupil, and surrounded more or less with fine downy feathers, which in some of the species form a complete circle, which nearly hides the bill. Their external ears are hidden by feathers, but they have large cavities in the skull, and the sense of hearing is presumed to be very acute. Their bodies, in consequence of their thick and downy plumage, are very small and light in proportion to their apparent size; and their bones have not the general strength of those of the preyers by day: their beaks also, though hooked and very sharp, are much more slender, and without any notch in the mandibles. Their tarsi are weaker; and their claws, though very sharp, are much more slender in proportion to the size of the birds. Their feet have three toes in front and one behind; but the outer toe is generally capable of being reversed, so that the toes act two against two, in clutching. Some of them have erected feathers, or a sort of crests, upon the sides of the head, which have procured them the names of horned owls or sacred owls; and those which are without these crest feathers are called smooth-headed owls.

Though in general timid birds, preying in the dark or the dusk, there are some of them of more bold and powerful character, venturing abroad during the day, especially in gloomy weather, and committing considerable ravages upon birds and the smaller quadrupeds. These are, however, chiefly inhabitants of northern and thinly inhabited or uninhabitable regions; and they rarely approach the dwellings or the possessions of man, and cannot be said to do much or material injury.

From the nature of their food, which is chiefly the different species of mice and other small and destructive quadrupeds, of which they capture vast numbers, owls may be regarded as among the most serviceable of wild birds; and those species which are of the greatest use are so far from timid or retiring in their manners, that they resort to farm-yards, barns, and other places, and perform their services, even in spite of the persecution which they meet with from the thoughtless; and were they encouraged and protected in proportion to the usefulness and the assiduity of their labours, there is no doubt, that they might be made to add both to the value and the interest of most parts of the country. For notices of the species, see Owl.

ACEPHALA (literally "having no head"). The fourth in order of the six classes into which Cuvier divides the Mollusca. (See Mollusca.) The grand character of the class, by which the whole of the numerous orders, families, and genera, which are comprehended under it, are distinguished from all the other mollusca, is that of having no visible head or neck, the mouth being merely an opening in the common integument of the body, without jaws, teeth, or any hard parts whatsoever. They are also without organs of sight or hearing, or indeed any allocated parts which we can pronounce to be organs of any sense; so that we can say nothing about the extent or the kind of their sensations. The mouth is situated under the cloak, or in its duplicature; the cloak being, in the majority of cases, double, and folded over the body, sometimes with the lobes free for their whole length on the under part; at other times united in the posterior part, so as to form a tube; and at others, again, united for the greater part of its length. Their organisation is very simple,—there being, in many of the species, very little distinction of gullet, stomach, and intestinal canal, but merely one continuous tube, which has few convolutions. Their nervous system is equally simple, consisting of one ganglion situated on what may be considered the gullet, and generally two further down; but these last, as well as the cord by which they are united to the first one, are often so obscure that they can hardly be traced. They are all understood to be self-fertilising, as well as bisexual; but still, production is no more spontaneous in them, than in those animals which have the sexes in separate individuals. A single individual can, however, soon stock a considerable space with them, as, under favourable circumstances, they are very prolific. They are all inhabitants of the water; and indeed few or none of them have sufficient powers of locomotion for finding their food upon land. Some adhere to the rocks by peduncles or stalks; others are chained by byssi, or threads; some make use of these threads for motion; others move by means of the foot along the surfaces of rocks and other substances; others effect a leaping motion by suddenly shutting the valves of their shells; and others, again, make their way through the water by compressing their bodies and ejecting a jet against the water in the rear. Many are incapable of quitting the bottom of the water; and others bore into the mud, or rocks.

They are, as has been said, very numerous; and are also exceedingly varied in their sizes, forms, and habits. Some, as the genus *Chama*, are among the largest, if not the very largest, of invertebrated animals; others are very minute. Some, as the oyster family, are much sought after as food; others, as the various species vulgarly called pearl oysters or pearl muscles (the *Avicula margaritifera* of the Indian seas, and the *Unio margaritifera* of many of the British rivers, especially in the northern parts of the country), are much esteemed for the pearls which they afford. Some are equally mischievous, as the *Teredo navalis*, which bores into the timber of ships, perforating it till it has the appearance of a honey-comb.

There is one circumstance attending this class, which is more favourable to a useful knowledge of it than any thing that is to be found in those tribes of aquatic mollusca which have free range of the sea, and can ascend and descend in the waters at their pleasure. Of these, more especially of such as, from the forms and qualities of their shells, we would naturally infer to be the most interesting, hardly any thing is known but the empty shells; and the history of these, however minute or perfect it may be, bears about the same relation to the history of the living animals, as a history of the costumes of different nations would bear to the history of those nations themselves. It so happens too, that the univalve *pelagic* shells, whether unilocular or multilocular, that is, whether they consist of one chamber or of many, which inhabit the depths of the ocean, and, upon the general principle of all sea animals, are not cast upon the shores till they are dead, are the most striking in their forms and the most beautiful in their colours. They are, therefore, those which are most eagerly sought after to stock the cabinets of the curious; and the consequence has been that, in as far as molluscous animals are covered with shells, the science of them has become a science of shells rather than a science of animals—a peculiar department of mineralogy rather than a part of zoology. Now, as the acephala inhabit the banks and bottoms at reachable distances, many of them without low water mark, and none of them beyond the reach of dredging (at least so far as is known), they form a branch of this very interesting department of nature, which can, to a very great extent, at least, be studied zoologically; and the habits of the animals themselves, as well as the mere forms of their encasements, can be made matter of science.

The acephala admit of a very convenient division into two sections—those which have shells, and those which have not. The first of these are usually styled *conchifera*, or shell-bearing; and the second *tunicata*, or cloaked.

Acephala conchifera have the shell in all cases external, and divided into two valves, which vary much in their form, size, and mode of articulation. Cuvier divides them into families, each containing many genera; and the names of these families are as follows: *Ostraceæ* (the oyster family), *Mytilaceæ* (the muscle family), *Camaceæ* (the chama family), *Cardiaceæ* (the cockle family), and *Myeæ* (the family of gapers).

Mollusca tunicata. The members of this section are in all cases without shells, the body being invested with two cloaks or tunics, which are in some instances separated from each other, excepting at the natural openings of the animals; while in others they are united throughout their whole extent. In some the surface is smooth, in others it is rough; and others again have the power of forming to themselves a sort of artificial clothing by soldering or glueing all over their bodies little pieces of sand and shells. Some of them can move through the water by first inflating the body with that liquid, and then forcing it from the posterior aperture, by the contractile force of the muscles of their tunics. The anterior opening in the tunic is usually much larger than the other one; because, while in most, or all of the conchifera, the gills are freely exposed to the water as it passes between the open valves of the shell, the gills of the tunicata are always within the tunics; and the animals either draw in water by the mouth and pass it by the other opening, or inhale and expel it by one and the same opening, in a manner similar to the breathing of the cartilaginous fishes, and not very dissimilar to that of the mammalia.

The genera and species of this section are few, compared with those of the former; the following being the principal:—*Thalia*, *Ascidia*, *Botryllus*, *Pyrosoma*, and *Polyclinum*; the first and second having their tunics separate, and the remaining three having them united.

Further particulars of the families composing the first section, and the genera composing the second, will be found under their respective names.

ACEPHALOPHORA (Blainville). In the modern system of Malacology, an articulated molluscous animal, in which the head is not distinct from the rest of the body. It is without any sensitive apparatus. The body is generally flattened, enveloped in a mantle, divided into two lobes; very rarely naked, and most generally included in a bivalve shell. The mouth large, constantly concealed, without any trace of teeth or organs of mastication. The respiratory organs are always bronchial or aquatic, and hidden.

This class is divided into four orders. The 1st, *Palliobranchiata*; 2d, *Rudista*; 3d, *Lamellibranchiata*; 4th, *Heterobranchiata*; descriptions of which, with their divisions into families and genera, will be given under their respective names, in the alphabetical arrangement of this work. They embrace an extensive and beautiful portion of that part of the invertebrated animal kingdom called Conchology by former naturalists, whose system was founded on the testaceous covering of molluscous animals, which wholly covered, or only partially protected, certain portions of their bodies, without any reference to the structure and habits of the animal itself; the only natural and unerring guide in the study of this, as well as every other work of the great Architect of nature.

All animals of this class are naturally aquatic: a great number of them marine, but a few inhabit lakes and rivers. They all feed on microscopic animals, or animal substances, in nearly a molecular or extremely minute state of division.

ACER (the Maple). A family of hardy trees and shrubs, chiefly natives of Europe and North America; belonging to the Linnæan class and order, *Polygamia Monœcia*; and to the natural order *Acerinæ*. Generic character: Calyx, more or less deeply divided into five parts; petals five; stamens, generally five to nine in number; one style, two stigmas; ovary dedymous; leaves simple, opposite, and generally divided into several distinct lobes; seeds two, each with a wing.

This genus contains about thirty species and varieties, and is arranged by botanists into four divisions, founded on the form of the leaves as entire, and, five-lobed, or cleft. They are all readily raised from seeds, and also by layers, cuttings, and budding; directions for which operations, together with descriptions of the more important species, will be given under the article Maple.

ACERA (Lamarck). Animals belonging to the fourth order, *Gasteropoda*; second class, *Paracephalophora*, of Blainville's system of Malacology, fourth family. The body more or less globose, gasteropod, divided into two parts, the anterior of which is often provided with lateral lobes; the head indistinct, without tentacula, or only with rudimental ones. There is no internal or external shell.

ACERINEÆ (The Maple Family). The forty-fourth order of the natural system of Jussieu, containing two genera and fourteen species of valuable forest-trees. They abound in North America, and all over the North of Europe. The foliage is more beautiful than the flowers, the latter being generally small, and by no means showy. They all receive the common name of maple, except the *Acer pseudoplatanus*, which is called sycamore, and in Scotland the plane-tree. The timber of almost all the species is valuable for very many purposes; especially to the cabinet-maker, the turner, musical instrument-maker, and for the manufacture of alkali, the maples of North America, are of great value. The sap of all yields sugar in considerable quantity; the *A. saccharinum* being the chief rival of the sugar-cane. For obtaining this precious article in North America, Michaux informs us that the following means are had recourse to:—In February or March, while the cold is still intense, the bole of the tree is bored in two places, five inches apart, at about twenty inches from the ground, and on the south side of the tree. The auger used should be somewhat more than half an inch in diameter, and the holes are made in an obliquely ascending direction, and to the depth of half an inch into the alburnum or wood of the tree. Into these holes tubes or fossets are fixed, ten inches in length, to receive and conduct the sap into troughs, placed below. The sap continues to flow pretty copiously for a month or six weeks; after which time the flow declines. Four gallons of sap yield about one pound of sugar, and from two to four pounds is the usual produce of a tree of the average dimensions, and growing upon average soils. During the sugar-making season, sheds are erected in the wood, for carrying on the boiling and other processes connected with the manufacture. Three workmen are allowed to attend 250 trees, which give on an average 1000 pounds of sugar. The United States are said to produce ten million pounds per annum of maple sugar.

It is the old butts of this tree which yield the beautiful veneers called *bird's-eye maple;* but to procure this in its finest shadings of the grain, much skill is required in cutting it up.

The ash-leaved maple, *A. negundo,* was formerly ranked in the Acer family; but has been separated by Moench, a German botanist, and now made a genus of itself under the generic title of *Negundo,* and of which there are two species; viz., *N. fraxinifoliam,* and *N. crispum.*

The generic character of the order is—Flowers polygamous; calyx five-cleft; corolla five-petaled, spreading, or none; germens two or three superior; seed single, roundish, its capsule terminated by a wing.

ACETABULARIA (Lamouroux). A genus of umbel-shaped polypidoms or corallines; the stem branchless, slender, fistular, and terminated by a striated radiated umbel, either flat or slightly funnel-shaped.

The Acetabulariæ partake of the characters of the Tubulariæ and Sertulariæ, by the situation of their polypi, each being placed in a distinct tube, and participating in a common existence by means of the stem, to which the lower part of each animalcule is attached; these tubes, which are very visible and projecting in the lower part of the umbel, blend and disappear when they reach the stem; they form distinct lines on the upper part of the disk.

They are found in thick tufts on rocks and solid marine substances; in the first stage of their development, the tube attains its full size, and the umbel is extremely small in diameter; by slow degrees this enlarges and acquires its full size; when it has attained that point it merely increases in solidity, and soon after perishes; many circumstances inducing a belief that these polypidoms have but a short existence. In the sea the stems are flexible, gelatinous, and of a greenish colour, the disks occasionally displaying a very brilliant shade of green; some of these characteristics disappear by desiccation, and the polypidom becomes nearly white and very fragile.

They are found in the tropical and temperate seas of both hemispheres, seldom attaining more than four inches in height. Two species are described by Lamouroux, one of which is found in great numbers in the Mediterranean, and the other in the Antilles.

ACHATINA (Lamarck; *Bulla,* Linnæus). A class of mollusca belonging to the *Paracephalophora* of Blainville.

The animal inhabiting this shell resembles that of the *Helix,* though modern naturalists have very properly separated this elegant genus from those of Helix and Bulla, with which they were confounded by the Linnæan school. They are an elegant and numerous family of shells, in many respects resembling those of the genus *Bulimus;* but on examination the distinction is manifest. The columella is smooth and truncated, and the margin of the aperture never thickened, which seems to indicate that the animal breathes only air; and though not altogether incapable of existing in an aqueous element, probably derives its sustenance from the vegetation on the banks of rivers or stagnant pools, only occasionally venturing into the water from necessity rather than habit. The shell is oval or oblong, ventricose, striated longitudinally; aperture ovate, never thickened or reflected; a smooth straight columella, truncated at the base, without an operculum. They are oviparous; and one species, the *Achatina zebra,* produces a hard-shelled egg, as large as that of a small bird. Many species are clothed with an epidermis.

A. zebra. Fig. 1.

A. virginea. Fig. 2.

This genus is subdivided into four species. The 1st, oval and subventrical, *A. zebra. fig.* 1. The 2nd species, with the aperture nearly round, rather short, and an internal transverse callosity, *A. virginea.* The 3rd species, subturriculated, and with the last whirl attenuated in front, *A. glans.* The 4th species, distinctly turriculated, *A. columnaris. fig.* 2. This last is a reverse or heterostrophe shell, as are some others of the genus. These shells sometimes attain a very great size, and their inhabitants are said to be voracious eaters; all of them are properly terrestrial shells, and Lamarck enumerates nineteen species. None have ever been found in a fossil state. Their trivial name is *Agate Snails;* only two of the species are European. The others inhabit the warm countries of the two continents, and Africa abounds in some of the larger species. The internal structure of this genus is here represented in a sectional point of view.

ACHILLEA, or YARROW. A natural genus of herbs, belonging to class the *Syngenesia,* order *Polygamia superflua,* of Linnæus; and to the natural family *Compositæ,* order *Corymbiferæ,* of various authors. The name is derived from Achilles, the pupil of Chiron, who is said to have first used some of the species medicinally. There are about eighty known species, some of which are indigenous in Britain. They are bitter, aromatic, and more or less tonic and stimulating. The *Achillea millefolium,* milfoil or common yarrow, is abundant in Britain; and was formerly used in medicine, but it is now almost neglected. The Highlanders, however, still make an ointment of it, which they use for healing wounds. The *Achillea ptarmica,* or sneeze wort, was used to promote sneezing, and to increase the flow of saliva. Its roots were reckoned a substitute for the pellitory of Spain, and hence the plant formerly received the name of *Bastard Pellitory*. The *Achillea nana*, or dwarf yarrow, grows on the Alps, and is employed to flavour vinegar.

ACHILLEUM (Schweigger). A genus of fossil *Zoophytes*, separated from the sponges. The Achilleum was shown to be a distinct genus by Schweigger, and adopted by Goldfuss in his "Petrefacten," in which work he describes it as being polymorphous (many shaped), affixed, and of a reticulate hollow fibrous structure.

ACHIRUS. A genus of *malacopterygeous* fishes, of the flat form, and nearly allied to the sole, only they are wholly without pectoral fins. There are many species of them, and they even admit of division into two sub-genera; the *achiri*, properly so called, which have the caudal fin separated both from the dorsal and the anal by a small rayless space; and the *plagresiæ*, which have them united; the former have also the eyes on the right side of the head, and the latter have them on the left.

There is nothing peculiar in their habits, so far as is known. They are found in the shallows, and near the shores, in all the warmer latitudes; and they furnish an abundant supply of wholesome food to the inhabitants. As is the case with the whole family of the flat fish (*pleuronectes*), they remain generally near the bottom, where they find their food, consisting of the small animals which are deposited on the banks while the water is still; but they do not, as is vulgarly represented, stay there because they have no *air bladder;* for the sinking and swimming of a *living* fish do not depend upon specific gravity; most fishes, if not all, being specifically lighter than water, as is proved by the fact that they all come to the surface when dead, and even when sickly and dying.

The species are very numerous; but wherever they are found they differ but little from each other, or from the common sole of our own shores, either in a popular or an economical point of view. *A. marmoratus*, which is found abundantly on the coasts of the Mauritius, has the fins minutely spotted with black upon a pearl white ground, and the side in which the eyes are marbled with the same colour. Others are marked with smaller spots, and others again are striped; but these are mere distinctions in colour, upon which no character appears to depend. Wherever the water is not too deep for their habit, they are found in all latitudes of the warmer seas, and extend in the Atlantic, till, more northerly, they meet the common sole. None of the family, whether of this genus or of any other, appear to be in any degree migratory or discursive. Their form is not adapted for long voyages, and therefore they remain on their banks; and, wherever there is a bank with deposits of mollusca or other small animals, some of the species are sure to be found. It is probable that the molluscous food is one cause of the superior delicacy and flavour of their flesh.

ACHLAMYDEÆ. A general term, applied to those plants which have neither calyx nor corolla; this is the case with the willows, &c.

ACHNODONTON. An exotic grass. Linnæan class and order, *Triandria Digynia;* Natural order, *Gramineæ*. There are only two species, viz. *A. Bellardi*, Bellard's, which is a perennial; and *A. tenue*, slender, an annual.

ACHRAS. The name of a genus of plants belonging to the natural family *Sapoteæ*, the Sapota or Sapodilla Tribe; and the class *Pentandria*, order *Monogynia*, of the Linnæan system. The term *achras* is properly, the Greek name of the wild pear, and has been applied to this genus on account of some resemblance between the fruit and a pear.

Generic character: Calyx deeply divided into six segments; corolla six-cleft; six barren scale-like stamens, alternating with an equal number of fertile ones; ovary having from twelve to six divisions; fruit, a many-seeded apple, the seeds being enclosed in compressed osseous nuts.

There are two or three species known. The most important is the *Achras Sapota*, the common Lapota, Lapodilla Plum-tree or Bully-tree, a native of America, found near Cumana, the Caraccas, &c., and called by the natives *Nispero*. It is one of the largest trees in the mountainous woods of Jamaica, and attains a height of thirty or forty feet. It is a tree abounding in a milky juice, having entire coriaceous leaves, and axillary one-flowered peduncles. The fruit, when fully ripe, has a sweet, luscious taste, and is considered an excellent article for the dessert. If not completely ripe, and some say almost putrid, it is acrid, and cannot be eaten. The seeds are aperient and diuretic, and have been given in the form of an emulsion in calculous complaints. The bark of this and several other species, more especially the Achras or Lucumus Mammosa, is astringent and febrifuge, and has been used as a substitute for cinchona, under the name of Jamaica bark.

ACHYRONIA (Willdenow). An evergreen shrub, from New Holland. Linnæan class and order, *Diadelphia Decandria*. Natural order, *Leguminosæ*. Only one species has been described, viz. *A. villosa*, villous.

ACHYROPHORUS (Robert Brown). Linnæan class and order, *Syngenesia æqualis*. Natural order, *Compositæ*. Generic character: Receptacle chaffy. Calyx somewhat imbricated. Pappus feathery.

The *A. maculatus*, spotted-leaved, was formerly *Hypochæris maculata*, Linnæus.

ACIANTHUS (Robert Brown). A New Holland genus. Linnæan class and order, *Gynandria Monandria;* Natural order, *Orchideæ*. Generic character: Calyx of six unequal divisions, the three exterior terminating in points, the interior smaller; labellum small, entire, spread out, showing two callosities at the base, but without foliar appendices. There are three herbaceous, tuberous rooted, perennial species.

ACICARPHA (Jussieu). A genus belonging to the class and order *Syngenesia necessaria* of Linnæus. Natural order, *Calycereæ*. Generic character: Flowers capitate, opposite the leaves, having an involucrum of four or five divisions attached to the lower part of the ovarium; the inferior flowers fertile, the superior sterile; ovaries, united in one body. There are three species known, all originally from the continent of America.

ACIDOTON. Linnæan class and order, *Monœcia Polyandria*. Natural order, *Euphorbiaceæ*. Generic character: Calyx of from three to five divisions in the male flowers; females bearing above thirty stamens, having the filaments connected in a cylindrical tube; ovary with three short styles, bearing stigmas; fruit globular, with three places and seeds. A hothouse tree, native of Jamaica; one species only, viz. *A. urens*, stinging.

ACINUS, or GRAIN. A term applied to each of the small granular masses of which a compound berry, such as the raspberry or bramble-berry, is composed.

ACIOTIS (D. Don). Hothouse under shrubs. Linnæan class and order, *Decandria Monogynia*; Natural order, *Melastomaceæ*. Of this genus there are two species, viz. *A. discolor*, various coloured; and, *A. aquatica*, aquatic; both formerly belonged to Melastoma.

ACIS (Salisbury). Bulbous-stemmed perennial plants, from the South of Europe. Linnæan class and order, *Hexandria Monogynia;* Natural order, *Amaryllideæ*. Of this family there are five species.

ACISANTHERA (Jussieu). An evergreen hothouse shrub, a native of Jamaica. Linnæan class and order, *Decandria Monogynia;* Natural order, *Melastomaceæ*. Generic character: Calyx ventricose; corolla of five petals; stamens six, vacillating; capsule crowned by the calyx, many-seeded.

ACMADENIA. (Wendland.) An evergreen green-house shrub, from the Cape of Good Hope. Linnæan class and order, *Pentandria Monogynia;* Natural order, *Rutaceæ*.

ACMELLA (Richards). Biennial and annual hothouse herbs, natives of warm latitudes. Linnæan class and order, *Syngenesia superflua;* Natural order, *Compositæ*. Species, three.

ACMENA (Decandolle). An evergreen ornamental shrub, native of New Holland. Linnæan class and order, *Icosandria Di-Pentagynia;* Natural order, *Myrtaceæ*.

ACNIDA (Linnæus). Virginian hemp; an uncultivated annual herb, native of North America. Linnæan class and order, *Diœcia Hexandria;* Natural order, *Chenopodeæ*. Generic character: Calyx of the male flowers in five deep divisions, from the bottom of which rise five stamens; those of the female flowers are in two divisions, and almost surrounded by an involucrum of several leaflets; ovary crowned by from three to five sessile stigmas.

ACONITUM (Linnæus). An extensive genus of hardy herbaceous plants, natives of Europe. Linnæan class and order, *Polyandria Trigynia;* Natural order, *Ranunculaceæ*. Generic character: Calyxn one; corolla, five-petaled, upper ones arched; nectaria two, peduncled, recurved; pods from three to five. There are above 100 species, arranged into four divisions, founded on the varied structure of the flowers, number of seed vessels, &c. The roots are tuberous; and many of them are very dangerous poisons. The monkshood of our flower borders (*A. napellus*) is one of the most common and showy, and one in which the deleterious principle abounds. The plants of this genus are very generally distributed, being found in North and South America, Siberia, and Japan; Richards divides them into four sections, founded on their mode of flowering, &c.

This poisonous body is of an alkaline character, and we are indebted to Professor Brande for its first discovery. As this vegetable poison is likely to be taken through mistake, it may be advisable to point out the symptoms which rapidly follow its absorption in the stomach. It is usually attended by violent vomiting and diarrhœa, and the best remedy is to evacuate the stomach by large draughts of tepid water, and then to take repeated doses of olive oil and milk.

ACONTIA (Dart Snake). A genus of ophidian reptiles, very judiciously separated by Cuvier from the genus *Anguis*, or the snakes properly so called. In their organisation they are intermediate between the snakes and the true serpents. Like the former, they are perfectly harmless, entirely destitute of poison fangs; have the teeth very minute, and are incapable of either killing a large animal or swallowing any thing of much size; but they want those parts of the skeleton which render the snakes, properly so called, a sort of lizards; without external feet. (See ANGUIS.) They have no scapular bones, not even the rudiment of a pelvis; and, instead of a sternum, or breast bone, their anterior ribs are united by cartilages. The head has the structure of that of the lizards; and, as in them, the whole body is covered with small scales, and without those bony plates which fence the under part, and at the same time serve as organs of locomotion in the true serpents.

This genus are usually of but small size, gentle and timid in their manners; but not destitute of courage when pursued. Their mode of defence is to dart their whole body with considerable force against their assailants; but they do not resort to that if they can conceal themselves, and escape even with wounds. Their mode of progressive motion is a curious one; it is neither, strictly speaking, a crawl, as in the true serpents, nor a walk—even that sort of wriggling walk which snakes use by the help of the scapular bones, the sternum, and the pelvis, though destitute of feet. They carry the head and anterior part of the body erect, and work their way by means of a sort of wriggling motion of the rest of it. That, and their resemblance at a distance to some of the venomous serpents which are found in the same countries, cause them to be disliked and persecuted, just as the common and equally harmless snakes in this country are, because the viper is venomous, and they happen to have something of the same shape.

The species of these harmless reptiles are numerous, and distributed over many of the warmer and especially the more arid parts of Africa and Asia. In the former continent they are met with in most regions suited to their habits, from the shores of the Mediterranean to the Cape of Good Hope; and in the latter, they range from the Isthmus of Suez to China. In no place, and in no species, however, have they any formidable weapons to use, either against man or against any other animal of even moderate size. Their food consists of worms, and insects and their larvæ; and it is understood that they render considerable service to the people of the countries which they inhabit, by destroying noxious species, such as the locust and the white ant.

The accounts of these harmless creatures, which have been handed down in the writings of the poets, the historians, and even the naturalists of antiquity, may serve to teach a little caution in crediting what the same parties have recorded upon other matters. According to some, they could project themselves with so much velocity, as to pierce and transfix those against whom their motion was directed, as if they had been arrows shot from a bow, or javelins launched from the most powerful engines of ancient war; according to others, their bite was the most venomous of all the serpent race, and neither medicine nor *charm* could prevent its fatal effects; and yet these reptiles were then, as they are now, incapable of killing even a small animal. It is, of course, not known to which of the species those accounts allude; and it is evident that they have combined in their descriptions all the species of serpents, whether poisonous or not, of which there was even a rumour. All species that have the structure alluded to are, however, alike harmless; all have the same timid character, and the same disposition to keep out of the way; on that account, the number of species is not known, and of those that have been named the history is imperfect.

ACORN. The fruit of the oak, which grows as represented in the engraving. In times of scarcity

acorns have been used as human food in perhaps every country in Europe—in some parts of Spain even to this day. As the food of swine they constituted in early times a considerable item in the profits of manors, which were usually valued according to the number of swine that could be fatted in the woods. This was more particularly the case with our Saxon ancestors, who had large herds of these animals.

ACORUS (the Sweet Flag). A genus of plants containing three species, one being a British aquatic, and two terrestrial, from China. They belong to the Linnæan class and order, *Hexandria Monogynia*. Natural order, *Aroideæ*. The British sweet flag was formerly used to strew the floors of churches and halls on particular occasions; the bruised leaves yielding a grateful scent.

ACOTYLEDONOUS PLANTS. Are those in which the seed lobes are not present or indistinct. Vascular plants are peculiarly characterised by the presence of a cotyledon or cotyledons and cellular plants by the absence of a cotyledon. The former group corresponds to the phænogamous plants of modern botanists, and is subdivided into monocotyledonous, dicotyledonous, and perhaps polycotyledonous divisions, according to the number of the cotyledons proper to the species. This division has acquired its celebrity chiefly in consequence of its having been adopted by Jussieu as the basis of his natural system.

The latter group—the cellular, or acotyledonous plants—correspond pretty nearly in their extent to the imperfect plants of Ray, the cryptogamous plants of Linnæus, or the agamous plants of Humboldt, amounting, as it is said, to about 6000 species. Hence it will be seen that they embrace merely the lower grades of the vegetable creation—the Filices, the Musci, the Hepatscæ, the Algæ, the Fungi—being placed, as it were, at the bottom of the scale, and exhibiting, in their outward aspect, as well as in their internal structure, nothing of that loveliness of form, and but rarely that brilliancy of colouring, by which some of the other divisions of plants are distinguished. They are the first and rudest types of vegetable life, many of them consisting merely of a cluster of minute cells, or of minute threads, as in the case of *proto-coccus* and *byssus*; and many of them being, in fact, nothing more than a mere slime or mucus, as in the moulds and nostocs. Yet these minute and apparently insignificant tribes of vegetables are by no means useless or superfluous in the scale of nature. They are just what they should be to complete or keep up the integrity of the vegetable kingdom, whether it be by decomposing putrid and fæcal matters, or by preparing a soil fit for vegetables of a higher order. They are scattered over all climates and all quarters of the world, replenishing both earth and sea with vegetable life, and ascending even into the regions of the air, by the very lightness of their seeds or germs, to be wafted on the wind, till drenched with moisture they descend again, ready to cling to the soil that suits them, if it should be even the surface of the flinty rock, or to spread themselves over mountains of eternal snow, or to immerse themselves in the waters of the ocean. Thus many of the algæ, at least, sow their seed and germinate where no other plant could live. They grow up, and come to maturity, and perish where they grow, forming, in the process of years, a soil of some depth. First mosses, and then ferns, are found to follow in their train, leaving a soil deeper and richer still, till at last, in the revolution of ages, the very surface of the barren rock is covered with a soil capable of supporting the loftiest trees.

ACROCEPHALUS. An ornamental annual plant, belonging to the Linnæan class and order, *Didynamia Angiospermia*, and Natural order *Labiatæ*.

ACROCHORDUS (Warty Serpent). A genus of serpents, supposed to be of the innoxious kind, or those which have no poison fangs, found in the island of Java. Only one species has been observed with any degree of attention; and the history of that one is so imperfect, that naturalists are not agreed as to whether it strictly belongs to the serpents destitute of poison, or has a mode of poisoning of its own, by means of a peculiar bone which has been detected in the head, and without the ordinary apparatus of poison fangs.

From the little that is known of the observed species, the *Acrochordus Javanensis* of systematic writers, the *Aular cærrau* of the natives of Java, it should seem that the animal has no need for poisoning apparatus of any kind, which is commonly used by those serpents that have it, not for the purposes of war, but for the capture of prey, as the stomach of the one which was found by the traveller Hornstedt, previous to 1787, contained, not the remains of animal matter of any kind, but those of fruit. The form of the animal is as singular as that species of food is uncommon for a serpent. The head is rather small and depressed, the upper jaw projecting beyond the under one, and each jaw furnished with two rows of small but sharp teeth. The tongue is short, thick, and unlike the tongues of most other serpents. The scales are nearly of uniform size upon all parts of the body; they have three successive keel-shaped elevations. When the animal dilates the skin, which it has the power of doing to a considerable extent, the scales stand up like warts; and it is from that circumstance the animal is named.

The specimen met with by the traveller already alluded to, was a large animal, upwards of eight feet in length; and three inches in diameter at the thickest part. The form of the body is very singular; it gradually increases in thickness from the head to the insertion of the tail; and then becomes suddenly small, the whole tail being of trifling dimensions compared with that of many serpents. In the specimen alluded to, the tail was nowhere more than half an inch in diameter, or only about one-sixth of that of the body near its insertion. Nothing further is known of its habits, than that it was found in a plantation and had been eating fruit. From the number of persons who have visited Java since it was found without meeting with another specimen, it must be rare as well as singular.

ACROCOMIA (Martius). A genus of palms, natives of tropical countries, belonging to the Linnæan class and order, *Monœcia Polyandria;* natural order, *Palmæ.* There are eight species described.

ACROSTICHUM. A genus of plants containing nine species of foreign ferns, in the Linnæan class *Cryptogamia Filices.* There are three divisions of this genus, founded on the forms of the leaves; viz. undivided, divided, and pinnate. All the species of this genus are natives of the warmer parts of both continents, but they are much more abundant in America than in the ancient continent.

ACROTRICHE (Robert Brown). A genus of plants consisting of three species of evergreen, greenhouse, New Holland shrubs. They belong to the Linnæan class and order, *Pentandria Monogynia;* natural order, *Epacrideæ.* Generic character: Calyx having two bracteas attached; corolla funnel-shaped; fruit, a drupe of five cells.

ACTÆA (Baneberry). A genus of plants belonging to the Ranunculus family, comprising only a few species; one of which, the *Actæa Spicata,* Black Baneberry, or Herb Christopher, is a native of Britain. This species has a creeping root, and a triangular, leafy, smooth stem. Its flowers are white, and grown in a dense egg-shaped cluster. Its berries are about the size of currants, and have a purplish-black colour; they are said to be poisonous. The root, given cautiously, has been useful in some nervous diseases. The whole plant yields a fetid odour, which is said to be relished by toads. Sheep and goats eat it; while cows, horses, and swine refuse it.

ACTINIA (Linnæus, Lamarck, Cuvier). The first genus of the class *Acalepha.* These beautiful and wonderfully organised animals, when expanded in search of their food, may be compared to full-blown flowers, elegantly striped, spotted, or variously marked with the most vivid hues; their trivial name is the SEA ANEMONE, which flower they greatly resemble.

The animal possesses a cylindrical, fleshy, simple, and very contractile body, attached by its base to rocks placed within the reach of the flowing tide; they rarely exert any locomotive power, though they certainly possess the faculty of removing from one place to another; their mouth, which is the only opening to the body, is terminal, and furnished with teeth, surrounded by one or more ranges of tubular radiated tentacula, disappearing when the animal contracts its orifice, in which state it is not unlike a ripe fig, or a small closely drawn purse. The coriaceous skin which covers the Actinia enables them to assume various forms, they are sometimes flattened, conical, or cylindrical. The *Actinia verrucosa,* or Great Actinia, inhabits the coasts of Great Britain, and many other northern countries, in some of which they are considered delicacies for the table. In the tropical climates numberless elegant species abound.

They feed on small molluscous insects, shell-fish, shrimps, &c., but principally small sea-crabs, which they draw into their mouths with their tentacula, ejecting the shells or other indigestible portions by the same opening; these tentacula, being tubular, appear to attach themselves by creating a partial vacuum in each of them, as no viscous fluid is absolutely perceptible on touching them, but a gentle suction is distinctly experienced. The whole interior of the body forms but one cavity or sac; and from the great expansibility of the mouth, large shell fish may be swallowed without injury; but when the shell is so situated as not to be readily discharged by the mouth, it is said to be forced through the body, making a wound near the base, which readily heals, without occasioning any apparent inconvenience to the animal.

They possess the power of changing their place; but their locomotion is extremely slow, and performed by the animal detaching itself at the base, reversing its body, and using its tentacula as legs, these being probably furnished with a viscous exudation, and a roughness well calculated to effect the office.

The Abbé Dicquemarre details some curious experiments on the extraordinary reproductive powers of these animals, in the Phil. Tran., vol. 63, p. 361.

He, in the first instance, cut off the tentacula, which were again produced in about a month, repeating this a second and third time with the same result. The upper part of one of the animals being also cut off, the base was found a few days afterwards to have fallen from its place, but it soon recovered its limbs.

After cutting one of them in two, the abbé presented a piece of a muscle to the detached part, and the limbs seemed eager to take it; they drew it into the mouth, and it was swallowed; but as the body was wanting to receive it, the piece came out at the opposite end, just (says the abbé) as a man's head, being cut off, might be supposed to let out at the neck whatever was taken in at the mouth: it was offered a second time, and again received and retained till the following day, when it was thrown out. In this manner it was fed for some time, the pieces, when they did not pass through, appearing considerably altered on their reappearance at the mouth. If the base itself of any of these anemonies be injured by an incision, the wound generally proves fatal to the animal.

On being put under an exhausted receiver, these animals did not seem to experience any ill effects, or to exhibit any inconvenience from being deprived of atmospheric air; if their tentacula were expanded when thus placed in an air pump, they remained so, and not the least contraction could be perceived on withdrawing the air.

Some of these actinia lived upwards of a year without any other food than the animalcula afforded them from the sea-water.

When shell-fish, pieces of fish, or raw meat, were offered, if not too large, they were always swallowed. The shells, even if closed, they ejected in the course of a day or two, but perfectly cleared of their contents.

The animals are all of them viviparous, and bring forth their young alive at the mouth, and the abbé states that he witnessed their production several times; they were generally from eight to twelve in number. Though at this age some of them were nearly imperceptible, they immediately attached themselves to the nearest object, and expanded their tentacula in search of food.

These animals, though destitute of eyes, were evidently affected by light. When a candle was placed near the vessels containing them, at such a distance as not to impart any heat, they regularly closed, and did not again expand till after the light was removed. When, however, they had been plentifully fed, they contracted more slowly, and sometimes even remained open.

The abbé, among other experiments, placed a narrow slip of meat in such a position as to enable two of these animals to seize either end—an animated contest commenced between them to gain possession of this piece, each in turn drawing in the greater portion; this lasted about three hours, at the end of which, one of them having lost its hold, its antagonist gained the prize.

In Hughes's History of Barbadoes a minute account is given of one species of actinia, which he considered *a sensitive plant, having animal properties.*

The actiniæ are incapable of supporting a strong light or great degree of cold; loud sounds affect them, and fresh water kills them; when they are seen expanded, they indicate fine weather with greater certainty than the barometer; when left by the tide for any length of time they contract themselves, remaining filled with water, which they eject with great violence when irritated.

These animals, like the polypi, have prodigious powers of reproduction; they may be separated transversely or vertically, and each foliated tube becomes a distinct animal; and some time after perfectly formed small actiniæ issue from the mouth.

When forcibly detached from their base, the lacerated portions, which remain attached to the rock, continue to live; their volume increases; the form swells; its mouth, stomach, and tentacula become developed, and a perfect actinia is re-produced. These again produce from the latter part of their base globules, buds or shoots, which are detached by themselves, and, fixing in their turn to the neighbouring rocks, produce fresh colonies.

About thirty species are known. only one of which, the *actinia viridis*, possesses the property of stinging the hand when touched, a circumstance almost constantly observable with the medusæ. Some species of actinia are eaten, principally in the hot climates, where they are far more numerous and infinitely more beautiful than in the northern latitudes. They are found in all seas, lining the vaulted caverns of rocks, below high water mark, or attached to the surrounding masses; and, in general, each species selects its particular habitat. The term Zoophyte, or animal plant, has, by many naturalists, been applied to these animals in common with the corals, corallines, and other polypidoms, equally improperly so named, as it merely arises from a singular coincidence of external resemblance without being founded on any physiological affinity. In proof of which one fact alone will be conclusive, that of their having one or many mouths, leading to an alimentary cavity, or organ of digestion, which does not exist in any vegetable.

ACTINOCAMAX (Miller). A genus of fossil *Cephalopodous Mollusca*, established by Mr. T. S. Miller, who describes it to be closely related to the Belemnites.

Generic character: "A club-shaped spathose concretion, consisting of two nearly equal longitudinal adhering portions. Apex pointed; base, a convex but obtuse cone. The whole formed of a series of enveloping fibrous laminæ."

For a considerable time these fossils were supposed to be either spines of echinites or belemnites, to the latter of which they have a very close affinity. From the first they may very readily be distinguished by their retaining their original laminated fibrous structure; whereas fossil echinital spines, when broken, always exhibit the uniform substance of crystalline carbonate of lime, with the constant fracture of the primitive rhomboid.

From the belemnites they may at once be separated by their not possessing the conical cavity or alveolus for the reception of the chambered shell; but are terminated by a protruding cone similar to the spines of cidarites.

With regard to the precise situation which this genus holds in the system of nature, together with many others, it is only possible to reason from analogy; and the tendency of that evidence is, that it belongs to the class *Cephalopoda*. In following out these views, it appears that actinocamax is the bone or *sepiostarium* of an animal belonging to Lamarck's division of the *cephalopodes*, the *sepiaria;* while the belemnites arrange among his *polythalamia.*

These views, first promulgated by Mr. Miller, have since received particular elucidation from the pens of M. H. Ducrotay De Blainville (Mémoire sur les Bélemnites, Paris, 1827), and P. L. Voltz (Observations sur les Bélemnites, Paris, 1830), &c.

This genus as yet appears to be geologically peculiar to the chalk formations of England and Normandy.

ACTINOCRINITES (Miller). A genus of fossil animals of the class *Radiata*, forming a distinct family, first established by Mr. Miller, under the name of *Crinoidea*, or lily-shaped animals (particulars of which family will be given under that head).

Portions of these fossil remains have been long known under the ambiguous names of wheel stones, fairy stones, rosary beads, trochites, entrochites, &c.; but it is to Mr. Parkinson we are indebted for the true nature of these singular and interesting remains, who described a species of this genus under the name of the *Nave Encrinite*, from its resemblance to the nave of a wheel. The characters of this genus are thus defined:—

"Animal having a round column composed of numerous joints, perforated by a round alimentary canal. At the summit of the column is placed a pelvis, formed of three plates, on which five first costals and one irregular costal adhere, which are succeeded by the second costals and intercostals and scapulæ; from whence five arms proceed, forming two hands, with several tentaculated fingers. Round side arms proceed at unequal distances from the column, which terminates at the base in a fascicular bundle or root of fibres."

The remains of this genus pervade the transition and carboniferous limestone series of this country.

ACTINOLITE. A mineral of a green colour, forming an interesting variety of hornblende. It is divided into Asbestos Actinolite, Common Actinolite, and Glassy Actinolite. The first of these appears massive, in distinct concretions, and internally the lustre is remarkably brilliant. It is found in gneiss, mica-slate, and granular limestone. Berzelius, on exposing this mineral to the action of a blow-pipe, found that it was not altered by moderate ignition; in a brighter heat it whitened, and was then converted into a yellowish brown opake glass. Vauquelin thus describes its chemical constitution:—

Silica	47·0
Lime	11·3
Magnesia	7·3
Oxide of iron	20·0
Oxide of manganese	10·0
Loss	4·4

Mr. Children, in his valuable notes to Berzelius, describes a specimen from Taberg, near Philipstadt, as consisting of one atom of trisilicate of lime, and three compound atoms of bisilicate of magnesia and protoxide of iron.

The common actinolite occurs in a variety of forms, and is found in great beauty at Loch Eil in Inverness, and in the neighbourhood of Redruth, Cornwall; it is also common in the northern parts of Europe.

The glassy actinolite is usually of a mountain green colour. It occurs in primitive rock in the Isle of Skye, and in various parts of Europe and Asia.

ACTION OF ANIMALS. The action of animals is a subject of the greatest interest, not only as displaying that beautiful harmony of organisation and purpose which is conspicuous throughout the whole of living nature; but because, in the organs of animals, and the actions which they perform, we find the most perfect models for the various species of machinery employed by human ingenuity. Their actions must be considered as threefold, or depending upon three distinct sets or systems of principles or laws. In the first place, as the body of the animal is matter, it must obey the mechanical laws of matter; so that neither the whole, nor any part of it, can move without the exertion of a force sufficiently powerful to overcome the resistance of inertia and gravitation. A finger cannot be stretched or bent, an eye cannot twinkle, or adapt its focus to an object at a different distance, without an effort as much greater than the result as is sufficient to overcome the inertia of the organ. This effort must have a certain magnitude before we can feel it, just as all objects of the senses must have a certain magnitude before we can perceive them; but as we can virtually analyse the object of sense down to the ultimate atom which cannot be supposed to become less, so can we analyse the effort down to its minimum. But in many cases we feel fatigue, either from the intensity of the effort or from its continuance; so that standing with the feet close, the body erect, and one arm down by the side, we feel the keeping of the other arm horizontally stretched, for even ten minutes, more fatiguing than if we allowed the body its natural play and carried a hundred weight for the same time. It cannot be the *matter* in the body which thus becomes fatigued? The stone never tires in lying on the ground; the planet in its orbit (though the motion, in the case of the earth, is more than sixty thousand miles in the hour) is never fatigued, or requires rest. That which gives the effort is fatigued and exhausted by giving it, and fails in being able to give it beyond a certain limit; it is not matter, but something which, to a certain extent, controuls and overcomes the ordinary properties of matter, whether that matter be in the body of an animal, or in something external of it. This power of overcoming the laws of inanimate matter is what we properly term *animal power;* and the result of it, the only means that we have of judging of the power, or knowing of its existence, is *animal action.*

But, secondly, the animal power ceases to act, if it is not accompanied by certain chemical changes, the occurrence of which, in opposition to the ordinary chemical action of inanimate matter, proves that it too is the result of *animal* power. The chemical combination of the food, be that food what it may, must be wholly changed by the process of digestion; new matter must be added to all the parts of the body, and that which is no longer fit for the purposes of life (the waste and rubbish as it were) must be removed out of the system, by various external avenues, and generally from the internal and more delicate parts, by the action of the air upon the blood and of the blood upon the air, in the operation of breathing. It has often been poetically as well as popularly said, that the air in this operation is the life; and even those who might have been expected to write *advisedly* at least on the subject have gone into arguments to prove that the air is really a vital fluid, that it is the source of *animal heat,* and the preserver if not the fountain of animal life; but truly there is no vitality in the air, or in any component part of it, neither is there in *any one substance* a store of *heat,* or of any other energy, *substantively* accumulated, and producible without the action of something else. The breeze would play long enough over the pasture, ere it awakened the most kindly herbage into sheep; and the storm might rage for ever among the mountain crags, without animating these crags into eagles. The natural action of the air is to *cool* that against which it beats; the air which is discharged from the lungs is warmed as well as changed; and if that which is received into the lungs is so nearly of the same temperature with the body as to exert no cooling influence there, the breathing of it is always unwholesome and laborious. The heat and the chemical changes which take place in the living body, like the mechanical action of that body, take place in opposition to what would be the state of things around if life were not there; and when life is extinct, the matter over which it held controul is yielded up to the common laws of matter: the body falls prone on the ground in obedience to the law of gravitation, and it decomposes and moulders in obedience to the laws of chemistry, with a rapidity proportional to the intensity of their action.

The power which the animal has of controling the mechanical and the chemical laws of matter begin, increase, fade, and cease together; and while they remain in action, every effort of the one is followed, or rather we may say, contemporaneously accompanied by a similar effort of the other. The power in the one animal is therefore *one* power—the physiologic power —the power of life, of which, from the very nature of things, we can know nothing further than we are able to infer from the results of its action, which is, indeed, all that we can know about power of any kind.

Of the chemical actions of animals we can know but little, or rather nothing; for chemical action is between particle and particle, even in dead matter, and the result even there is always mechanical before we can observe it; therefore, in speaking of the action of animals as a subject of rational and useful, and even of entertaining knowledge, (for that which has no meaning cannot entertain much or long,) we must confine ourselves to their mechanical action. Even there, we must exercise some caution in order to see clearly the beauty of the subject, and to learn successfully those practical lessons which it can so abundantly furnish.

When it is said that the power of life in an animal opposes or counteracts the common laws of mechanics and chemistry in matter not animated, it must not be understood that these laws are violated, or that the properties of matter are, in the least, either changed or destroyed. If creation were thus unstable, it could not endure: if the properties of matter, which belong to it simply as such, and without any reference to composition or combination, were not co-existent with matter, inseparable from it for an instant, and capable of perishing only with its final destruction, there would be an end not only of all knowledge of matter, but of all matter to be known; for, other than by its properties, we do not, and we cannot, know any thing of matter. But the changes, whether the chemical ones of combination, or the mechanical ones of place, are open to our observation, and an endless variety of them is perfectly consistent with perfect sameness in the properties of matter abstractedly considered. The same particle of carbon, for instance, may be at first a diamond, may pass in succession through every animal and every vegetable, and every mineral, that can contain carbon in its composition, may travel millions of times round the globe in the course of its varied combinations, yet maintain its perfect identity of essence and qualities all the time, and return to a diamond at last. That principle is true, not only in the case of animal action, but in that of all action among matter, whatever we may suppose to be its cause; and therefore it is of the utmost importance that respecting it our perception should be clear and our understanding sound. Having noticed it, and it is one of those subjects which should frequently be repeated as a preface, we shall very shortly advert to the general principle of mechanical action in animals. Their actions are all motions, or the results of motions of some sort or other, or they are active resistances to external motions, which, in principle, amount to very nearly the same. If in one instance an eagle cleaves the still air at the rate of fifty miles an hour, and in another it maintains its perch on the pinnacle of the rock, while the tempest sweeps around it with the same velocity; or if in one case a fish darts through the stilly pool with any degree of rapidity, and in another keeps its place in a current which is racing onward just as fast; the mode of action may be different, but the intensity, or, as we may call it, the quantity of action, is the same in both: but, in judging of these actions, we must bear in mind that there is one element of which we are very ignorant—the *energy* of the animal. That is not in proportion to the mass; for if man had the energy of the ant, he could *walk* over a city in a straight line, without heeding the buildings in his way; and if an elephant had, bulk for bulk, the same energy as a flea, it could clear London at a single bound.

The action of all animals may be said to be the result of muscular energy, though the effect of the muscular exertion is, sometimes, increased by structural means. Thus, when the tendon of a muscle passes over the processes of a joint, the tendon is as much pulled by bending the joint the other way, as it would be by the action of the muscle. By that species of action all birds maintain their footing, all perching birds their perch, and birds which kill their prey by clutching or trussing it against the ground give effect to their talons. All animals, indeed, can give different degrees of stability to their feet, by different bendings of the limbs; and these flexures are not so much shiftings of the centre of gravity, as of the part of the base on which the chief pressure rests, though, if the object be mere stability, the centre of gravity is speedily shifted by other flexures, so as to bring the pressure equally upon all parts of the base, and of course nearest to that part which is in the state of greatest tension and best capable of resisting. Bending the knee, or, which is the same in effect, bending the ankle joint, pulls the great tendon of the heel, as forcibly as it could be done by the contraction of the muscles of the calf. If it be done suddenly by a blow behind, when the body is in a very erect position, and the weight chiefly on the heels, the sudden pressure on the balls of the feet in advance of the centre of gravity is very apt to throw the body flat on the back; but in leaping, when the body is bent forward on the hip joints, the very same position of the leg throws it upward and forward when the leap is taken.

Animals which repose on the feet do it, not by muscular exertion, for that is inconsistent with repose—they do it by this adjustment of tension upon the tendons; and if it is against a current, by adjusting the body to that current. When a man stands with his face to the wind he must bend so far forward as to advance the centre of gravity, till the tendency he would have to fall if the wind were not blowing be equal to the force of the wind; and if he stand with his back to the wind, he must lean as far backward. A man has, however, less command of himself with the wind in his back than in his face, just as he has more command of himself in climbing a hill than in descending one; and the cause is, that in facing the wind and in ascending, the tendon alone brings the ball of the foot into action, and there are the muscles of the calf to assist; whereas, in the other cases, the muscles are always in action, and the muscular energy wears out.

Quadrupeds for the most part repose prostrate; but it will be found that all those which repose on the bended legs repose on them so that the tendons are stretched, and will assist as a spring in rising. That is remarkable in the couchant attitude of some of the dog tribe, more especially in greyhounds, and also in cats preparatory to taking their spring—a position in which we may conclude that both muscles and tendons are in that state in which they can act most simultaneously and with the greatest energy.

The positions of birds when perched are well worthy of attention, as they show the perfect state of "preparation for action," in which all living creatures in a state of nature are, when they are at rest, so that in case of surprise they are never taken unawares, or at a disadvantage. Birds on their perch always face the wind; and though many of them "give themselves to," or "turn down" the wind, especially in attempting their escape from rapacious birds, which have not that habit, they all rise with their heads to the wind, and when they "turn down," it is by an oblique posture of the body, and an oblique lateral motion. If a bird were to perch with its tail to the wind, there would be two tendencies to drive it from its perch: the wind would, by turning the feathers, and even getting under the wings, have great power over it; and the action of that power would unbend the legs, and thereby loosen the feet from the perch. But perching with the head to the wind, the bird is enabled to make the wind itself a means of stability. The usual position of repose in a calm in perching birds, is not any effort to keep the perch. It is done simply by the adhesion which results from gravitation, and that too without moving a single muscle of the feet. When reposing, the head is either turned under the wing, or it is bent back, by contrary flexures of the neck, till it rests on or near the shoulders. The whole body is, in fact, concentrated upon that part of the spine which has little or no motion by joints.

The repose of all vertebrated animals is concentrated in the spinal column, which alone is very strong presumptive evidence that the brain and its spinal continuations are the centres or sources of all animal action; but the position of repose in that column varies with the structure and habits. When the spine is flexible, the position of repose is nearly half way between the extremes of the range of motion, or rather that range is divided in the exact ratio of the powers of the *flexor* and *extensor* muscles; and the articulation feels loose, so that the part may be moved to some distance either way, with little effort, and no pain or even disturbance. In the bird, however, which holds its perch by tendinous elasticity, the flexure of the neck is beyond that position which would be repose in a quadruped, so that the tendons of the extensors are tightened; and any cause, which agitates the perching feet, at the same instant brings the neck into action, and extends, elevates, or depresses the head, to the exact extent which the balance requires. Thus, there is in the very structure of the bird a means of resisting any casualty that might drive it from its perch, and that without any more of what we call will or even instinct in the creature itself, than there is *will* or *instinct* in the breathing or the circulating of the blood in man while he is asleep. The sleep, even when most profound and unbroken, is thus not a sleep of the whole animal, for the functions of certain parts of it are going on, and others are ready to obey, not the will of the animal, but external circumstances, as for instance the freshening or abating of the wind. The bird is thus never altogether asleep, neither can it be considered as wholly awake, until all parts of the system are in the full bent of their action.

The nicety with which branch birds bend the positions of their bodies to the fitful wind, or rather the way in which, without contrivance or purpose in either, the bird and the wind act in concert, are well worth noticing. The perch moves in obedience to the wind, or other cause by which it is agitated, and the bird moves along with it; but the bird has also a compensating motion in itself, wholly without design, by means of which, up to a certain degree of agitation in the perch, it maintains its balance with closed wings. When the agitation becomes too great for that, the wings are put out, just as a rope-walker uses his balancing-pole; and when the wind increases to a tempest, and the bird can maintain the perch no longer, it lets itself down by an oblique motion, with so much of the wind under it, as prevents it from being beaten to the earth, or injured by its fall. But to detail all the varieties of muscular action and tendinous relief or repose, with the different structures of feet, wings, and necks, which come into play in this one species of action, although it is one of the most simple branches of the subject, would fill volumes.

The subject, however, not only admits of, but points clearly at, one very general and important conclusion,—namely, that in all these adaptations, perfect and beautiful as they are, the bird profits not a jot, and proceeds not in the least, by what we call experience. And even we, fond as we are of taking credit to ourselves for plan and wisdom, find enough in the action of our animal frame to convince us that that action depends upon principles more stable, and is directed by wisdom more profound, than any to which we can rationally lay claim.

Now if in ourselves, and in the execution of those works of art which are the applications of scientific principles, we find that knowledge and manual dexterity are wholly different in their causes and means of acquirement, and that the chain by which the dexterity is arrived at can be followed downward unbroken, to the involuntary respiration and circulation during sleep, or to the balancing of the sleeping bird upon its perch, we must see clearly that the actions of animals, however complicated or curious, and our own action, in so far as that is animal, are the results of material principles, or rather they are the results of certain arrangements or organisations of matter; that the laws or principles by which those actions are produced are not properties of matter considered abstractedly, or (so to speak) as "the stuff of which animals are made," but principles resulting from the organisation, and from that only; that they do not arise from any property which matter itself possesses in its ordinary combinations and arrangements, but that (though it may in some cases be minute beyond our powers of observation,) there is always a distinct ACT OF ORGANISATION before a new organised being can exist; that though, in our estimation, some of them appear simple and others complicated, some involuntary and others voluntary, yet they are all equally simple and equally certain, never occurring but under the circumstances which accord with their occurrence, and never absent when those circumstances take place; that they are in perfect accordance with all the laws of matter, and have their origin, their growth, their decay, and their extinction, of creation itself, and neither require nor admit of being separated, though, as they depend upon combinations, it follows that, in as far as we can alter the combinations, we can change the result.

This view of the matter—and though it is not the usual it is the only correct one—the only one which will carry us, without nonsense in philosophy and infidelity in religion (twin progeny of the same narrow-minded ignorance) fairly through the analysis, from the eye of the eagle, the proboscis of the elephant, the human hand, or whatever else may be considered as the perfection of organisation, to the primary atom, in which gravitation itself is too minute for our observation,—mightily enhances the value of animal action. It lets us see that the whole of animated nature is in our power, and that we may, according to the extent of our knowledge, either enlist it directly in our service, or copy it as a model, in so far as that which has life can be imitated in that which has not.

Some account of the more obvious kinds of action in progressive motion will be found in the articles CREEPING, WALKING, FLYING, and SWIMMING; and some notice of the more peculiar ones, especially those of the invertebrated animals, in which they appear to us most singular, from having the least similarity to our own actions, will be found in the accounts of the animals by which they are displayed. The other branch of the general question, namely, the means that must be adopted in turning the action of animals to useful purposes, will be found slightly noticed in the article AFFECTIONS OF ANIMALS.

ACULEUS. A prickle attached to the bark, and coming off along with it. It is unconnected with the wood, and thus is distinguished from *Spina*, a thorn. Examples of it may be seen in the rose, the raspberry, bramble, &c.

ACYNOS (Richard). A genus comprising eleven species of European herbaceous plants allied to the common thyme. Some of them are biennials, others annuals. Linnæan class and order, *Didynamia Gymnospermia.* Natural order, *Labiatæ.*

ACYONIA (Leach). A genus formed from the genus *Scalaria*, to distinguish those species whose spiral turns are disconnected, and not touching in any part; but other naturalists have not adopted this genus, considering it at most but a variety, or perhaps merely a sport of nature.

ADAMANTINE SPA. *See* CORUNDUM.

ADANSONIA. A genus of plants which derives its name from the famous French botanist, Michel Adanson. It belongs to the natural family of *Bombaceæ* (Kunth and Richard), or the cotton-tree tribe; and to the class *Monadelphia*, order *Polyandria*, of the Linnæan system. The generic characters are: Calyx naked, deciduous, deeply divided into five segments; petals, five; style very long; many stigmas; capsule or seed-vessel woody, divided into ten cells, containing a farinaceous pulp and numerous seeds.

Isert, a Dane, in his voyage to Guinea, states that he observed several species of the genus; but the only one which has been hitherto known to botanists is the *Adansonia digitata* of Linnæus, the Ethiopian sour gourd. This immense tree, the colossus of the vegetable kingdom, is found in Senegal, Guinea, and the countries on the west coast of Africa, from the Niger to the kingdom of Benin. It was first introduced into Britain in 1724, and may be reared in a mixture of peat and loam, in bark or a moist stove.

The tree is called by the inhabitants of Senegal *Goui*, and its fruit *Boui;* while the French give the name of *Calebassia* to the former, and that of *pain de singe* to the latter. The designation of *monkey's bread* applied to the tree is derived from the French appellation of the fruit.

Its height is moderate, varying from fifty to sixty feet, but the size of its trunk is almost incredible. According to Adanson, trunks are met with having a diameter of twenty-five or thirty feet, and a circumference of ninety; and Mr. Golberry observed one which was thirty-four feet in diameter and 104 in circumference, while at the same time it only attained an elevation of twenty-four feet. The lower branches shoot out frequently to the length of fifty or sixty feet, at first in a horizontal direction. They are covered with a dense foliage, which, from its weight, causes the branches to bend towards the ground; and thus there is presented an immense hemispherical mass of verdure, 120, 140 or even 150 feet in diameter, and perhaps sixty feet in height. At a distance a full-grown tree almost presents the appearance of a forest. Cape de Verd is said to owe its name in part to the foliage of this tree, which adorns the whole of Senegambia and Guinea with its green elliptic arches. The flowers are very large, white, and pendent. At sunrise the negroes religiously watch the opening of the flowers which have been closed during the night. The roots are numerous, and attain a very great length. A main root has been measured 110 feet long. It flowers in July, and its fruit is ripe in October and November. The age to which the tree is said to live is astonishing. Adanson looks upon it as the oldest living monument of the globe. In 1761 he noticed two of these trees growing on an island off the west coast of Africa, which were distinctly ascertained to be several centuries old; and he seems to think that some trees on that coast have existed upwards of 5000 years. His conjectures are probably erroneous, but they are founded on the rate of growth of the trees. The following are his calculations, as given by Dr. Hooker: a tree of—

	Diameter.	Height.
1 year old is	1 or 1½ inch	5 feet.
20	1 foot	15
30	2	22
100	4	29
1000	14	58
2400	18	64
3150	30	73

From this it will be seen that the increase in height is not in proportion to the increase in diameter.

The wood of the tree is pale and soft, and is perforated by bees for the purpose of depositing honey, which is often found in great abundance. The trunk of the tree decays by disease, and is hollowed by the negroes into chambers, which are large enough to serve for temples or habitations. These cavities are, however, generally used as receptacles for the dead bodies of those denominated *guiriots*, that is, poets, musicians, &c.; for whom the negroes entertain high respect, as beings possessed of superior intelligence. They are respected, consequently, during life; and after death superstitious motives prevent the negroes from interring them in the usual way. Their bodies are suspended in the cavities hollowed out of this tree, and there they become completely dried, and are in a short time rendered perfect mummies, without the aid of any perfumes or embalming materials.

The tree is mucilaginous in all its parts, and is used for a variety of economical and medicinal purposes. The bark and leaves when dried and powdered form a substance called lalo, which is used by the natives of Senegal as a seasoning for their food, and which is employed medicinally, both in the form of powder and decoction, to diminish excessive perspiration, and to check dysentery and the epidemic fever, which rage in September and October after the rainy season has ceased. By the use of the decoction Adanson and a friend kept off the attack of fever at a time when it was remarkably prevalent, and were thus enabled to prosecute without interruption their scientific researches in Africa.

The fruit, which is ten inches long, has an agreeable acid flavour. It is used for food, and when mixed with water and sugar is a grateful drink in fever. The fruit is carried by the Mandingos to the eastern and southern parts of Africa, and sold to the Arabs, who convey it to Morocco and Egypt. The pulp when dried and powdered is an article of commerce, and is sold in the market of Cairo, under the name of Lemnian earth. The ashes of the outer rind of the fruit are mixed with rancid palm-oil, in order to form soaps.

A very full account of this wonder of the vegetable kingdom is given by Adanson in the Memoirs of the Royal Academy of Sciences of Paris, in the year 1761.

ADAPIS (Cuvier). A name used by Gesner as a synonym of the Daman, but applied by Cuvier to designate one of the fossil pachydermatous quadrupeds, discovered by him in that great bone repository, the gypsous formation of Montmartre.

In few instances could we point out a more illustrative example of the application of his favourite hypothesis, which he calls "*la loi des corrélations des formes*," or that of Harmony of Forms; the proper application of which enabled that illustrious naturalist and other anatomists to restore, and as it were repeople, the earth with animals which have long since disappeared from its surface.

Three portions of the head only have as yet been discovered among the multitudinous bones obtained from the plaster quarries; yet these alone, from their contour and dentition, are sufficient, when applied to the analogical test of the law before spoken of, to determine characters sufficient to distinguish them from any known animal either recent or fossil.

This animal may at once be distinguished by the following characters: Its general form must have assimilated to the hedge-hog, but larger; each jaw was furnished with four incisors, trenchant, and rather oblique, with conical canine teeth above and below, thicker and more projecting than the other teeth; the tooth a straight one, the lower oblique and couched forwards. The molar teeth appear to have been fourteen in each jaw; six were discovered in one side of the upper jaw, the first trenchant, the second encircled by a crest, the third apparently so; the other three like the posterior molars of the Anoplotherium. In the lower jaw, the two first molars are pointed and trenchant; the third similar, but longer and wider; the next three in form the same as the opposing teeth in the upper jaw; the last is oblong, and seems to have tubercles in the form of unequal transverse hillocks.

This animal, though probably not larger than a rabbit, appears to have closely approximated to the Anoplotherium.

The gypsum quarries, from which these relics were exhumed, belong to the tertiary formation, above the *calcaire grossier* and London clay.

ADDER'S TONGUE (Linnæus). A very small species of fern found in pastures on chalky clays. The leaf is an elongated cup, with one lip lengthened out to a point. The capsules are fixed on a central spike resembling a tongue, hence the name; capsule, roundish, one-celled, opening transversely, seeds angularly round.

ADELIA (Linnæus). A genus of three species of stove evergreen shrubs, natives of Jamaica. Linnæan class and order, *Diœcia Monadelphia;* Natural order, *Euphorbiaceæ.* The flowers of these shrubs are very small; calyx, from three to five divisions in the male flowers; stamens, thirty-one. In the female flower the ovary is surmounted by three stipules.

ADENANDRA (Wendland). A genus of evergreen shrubs, natives of the Cape of Good Hope. Linnæan class and order, *Pentandria Monogynia;* Natural order, *Rutaceæ.* There are ten species, some of them very beautiful.

ADENANTHERA (Linnæus). A family of evergreen shrubs, natives of India. Linnæan class and order, *Decandria Monogynia;* Natural order, *Leguminosæ.* Species two. Generic character: Calyx abbreviated, with five teeth; corolla of five regular petals; stamens ten, equal in length, and separate; anthers terminated by little glands; fruit a long pod, containing round seeds. The species which compose this genus have the leaves bipinnate, the flowers very small and in bunches: one species, *A. pavinonina,* is a large and beautiful tree, the seeds of which are round, of a bright red, and are used as food in some parts of India. The fruit is also used for necklaces and other ornaments.

ADENANTHOS (R. Brown). Greenhouse evergreen shrubs, natives of New Holland. Linnæan class and order, *Tetrandria Monogynia;* Natural order, *Proteaceæ.* Generic character: Calyx superior, tubular, four divisions; stamens four; style one; fruit a nut containing one seed. Species three.

ADENOCARPUS (Decandolle). A genus of deciduous ornamental shrubs, natives of Europe. Linnæan class and order, *Monadelphia Decandria;* Natural order, *Leguminosæ.* Generic character: Calyx, bilabiate, the upper bifide, the lower trilobate. Corolla, papilionaceous. Stamens, tenunited, with one distinct. Fruit a compressed pod. The valves covered with little pedicelled glands. This genus comprises six species.

ADENOPHORA (Linnæus). A genus of perennial herbs allied to campanula, chiefly natives of Siberia. Linnæan class and order, *Pentandria Monogynia;* Natural order, *Campanulaceæ.* Species fourteen.

ADEONA (Lamouroux). A genus of the third order of the third class of *Corticiferous Polypidoms,* so called from being composed of two substances; the one exterior, which may be termed the rind or incrustation; and the other called the axis, placed in the centre of the former, and supporting it. The organisation of the stem of the adeonas is articulated and surmounted by a fan-shaped expansion, both surfaces of which are impressed with small scattered cells, pierced with round or oval holes. Lamouroux, who has closely studied the interesting productions of these wonder-working creatures, appears to consider this genus as the natural connecting link between the corallines and the flexible polypidoms, that are entirely of a stony fabric, comparing it to a millepore fixed to the axis of an isis or of a mopsea; and although no rind has been discovered attached to specimens brought to this country in a dried state, there is every reason to imagine it does exist in a fresh and living state. Supposing that these beings do not change by desiccation, we must admit that in Australia these polypidoms afford us a new example of organised creatures which have no place in our classification of natural history, a circumstance not rare in that division of the world.

The difference between the fan-formed expansion and the stem in the animal is so great, that naturalists, at first sight, were tempted to look upon the two parts as distinct beings; it is, however, easy to prove that they belong to the same animal.

Peron, who had seen them in the very site of their growth, frequently convinced himself that they were identically the same polypidom. If the base of the fan-formed expansion of the adeona be attentively observed, it may be seen to extend itself into the stem, and only gradually to change its nature; when that change is completed in the stony articulations, the same stony substance forms the expansion, differing only from the articulations by possessing cells that are not found in the stem. These facts most conclusively establish that the stem of the expansion of the adeonas, notwithstanding their disparity of form, cannot be the productions of different animals.

The stem of this polypidom is irregularly cylindrical, sometimes branching, composed of calcareous articulations, without pores or cells, as hard as coral, and separated from each other by disks or plates of a horny, fibrous, and flexible substance. The expansion, as has been already observed, is stiff and brittle. Its hardness is equal to that of many of the madrepores, and superior to that of most of the millepores; the cells or pores are very numerous, placed in short curved lines, or dispersed on both surfaces; all those found on the same side appear to communicate with each other by very thin perforated divisions; and the polypi of the two surfaces appear to be insulated by means of a diaphragm, which is very thick, and parallel to the plane of the two surfaces, dividing the polypidom into two laminæ of an equal thickness.

The colour of the adeona is an iron-grey, sometimes of a deep hue; they occasionally attain a foot in height, and are abundantly found in Australia. Six species are known.

ADESMACEA. A family of shells, forming the third class of *Acephalophora*, established by De Blainville, in his System of Malacology. It includes the genera *Pholas*, *Teredina*, *Teredo*, *Fistulana*, and *Septaria*. All the species of these genera possess the extraordinary faculty of piercing hard bodies, such as marble, wood, &c. A more detailed account of the habits of each will be found in their respective alphabetical arrangements.

ADHESION literally means the property which substances have of "sticking together" after having once been separated, or of growing up united as one when, under other circumstances, they grow separately. The term is used in the arts and in the sciences of dead matter, and there it denotes the adhering together of different substances or different masses; and differs from *cohesion*, by means of which the parts of one mass are held together.

In Natural History the word adhesion has a signification somewhat different, namely, that the substances do not merely adhere together, but grow together, and become as it were one. In this sense it is applied to natural substances in their living state only; but it applies equally to animal and vegetable substances, and some of their most remarkable properties depend upon it.

There are some remarkable cases of adhesion that take place in animals, chiefly in the mammalia, though occasionally in some of the other classes, while they are in the uterus or other maternal envelope. These chiefly consist of the union of two subjects, neither of which is quite perfect: at times both nearly in equal perfection, as was the case with the Siamese twins, some time ago exhibited in London; and at other times with the one so little developed, that it seems merely a fragment stuck upon the other—as an additional limb, a finger, or a thumb. These formations, to which the name of MONSTERS has been given, form one of the most obscure portions of the branch of physiology, of which we know the least, inasmuch as we have no analogous knowledge upon which we can ground even a plausible conjecture, neither is it probable that such knowledge will ever be obtained. There are natural causes for their monstrosity no doubt, as well as there are for all the phenomena of nature; but we know not in what direction these causes may lie; and, consequently, any speculation concerning them would, of necessity, be extremely doubtful. If one lamb in a thousand be dropped with five legs, we need not puzzle ourselves about the cause of that, till we have found out "why" the nine hundred and ninety-nine have only four legs each. The number in the one case satisfies our curiosity, and the rarity of the other awakens it, but we are equally ignorant of the "why" in both.

Vegetable adhesions are turned to more account than animal ones; and we are enabled to pursue the subject a little farther, though when we come to adhesions in their primary formation, we get upon ground which is hardly less slippery. In vegetables we can carry the adhesions, at least in some of the natural families, to different species, and perhaps to the whole genus, or, in some instances, to the whole natural family or order. The cases in which we can most easily effect this, are those in which there is a power of forming lateral buds, or buds in the bark, or rather in the living cambium; but there are other cases in which it is difficult, if not impossible, to form an adhesion, even of the parts of the same individual, however recent the division may be. There is no action for the repair of waste in those parts of a plant which have passed their season of vegetation; and therefore we could no more expect a power of adhesion in them, than in the salts of lime in the bones or in the appendages to the skins of animals. It is at the living surface of the wood in the *exogenous*, or the living centre of the *endogenous* plant, where we alone ever find action; and as there is productive action there only while the cambium of the plant is in a state of granulation, there can be no healing or union by the first intention in a plant. It is true, that the action in perennial stems is not confined to the mere surface at which the new substance accumulates during the growth of the season; for there must be some organisation or apparatus for the elaboration of that substance; and thus the action of the vegetable may be said to linger a little longer in the external layers of the alburnum or sapwood, and the inner layers of the bark, according to the habit of the species. But when these structures are once consolidated, they do not unite even by a process similar to granulation; and hence the "internal shakes," which are found in the boles of trees, in those countries where they are exposed to the effects of violent winds. Hence also the union by grafting must be by means of a mere twig; and if that twig is inserted in the hard wood only, it is sure to wither; unless that mould decomposes and forms a soil in which it can take root. Even with the living surfaces of the scion and the stock in contact, there must be a sort of overlaying or overlapping of those surfaces; for though they are adapted ever so neatly to each other, they will not adhere upon a perfectly horizontal section.

The parts of growing plants are often subject to the same kind of adhesion which takes place in animals, when the parts are deprived of the epidermis, and held in contact. This often occurs naturally in trees which bud in the bark, and gives them very fantastic appearances: and it is not confined to deciduous trees, but is met with in some of the coniferæ, such as the yew, the old hollow trunks of which are often covered by a network of younger parts, which adhere and again separate over it in the most singular manner, entwined like open rustic work, after the old part has mouldered away. Fruits and leaves often adhere in the same manner; and indeed, in many species, there are no two similar parts of the living surface that will not adhere if they are deprived of the epidermis, and brought into contact.

This tendency is turned to account in the arts, in what is sometimes called a Dutch hedge, a description of fence which might be advantageously introduced in all places where land is valuable. It consists of twigs rooted in the ground, made to cross each other in lozenges, the surfaces being rubbed where they come in contact, and tied together till the whole unites into one solid piece, occupying only a few inches in breadth, and yet stronger than any hedgerow of detached plants.

All vegetable growth may be considered as proceeding by a sort of adhesive process, at least all which proceeds by a series of growths with pauses between, as in plants which continue to grow for several successive years, and more especially all which increase by layers on the wood and bark, and elongations of the twigs. In these, the part which is once formed, and has rested for one season of inaction, does not again increase its volume, either in length or in diameter; but the new parts are formed external to it, and produced upon it, by different degrees of adhesion, according to the nature of the plant.

This principle of adhesion, which of course is the only one by means of which plants, which are formed as it were by a succession of cases or deposits, which do not increase after they are once formed, could at all increase in volume, and which is in itself a *result* of the peculiar mode of action in the species, has been perhaps carried a little too far by those who are determined to know more of nature than nature itself reveals. It has been described, and that too by modern botanists, not only as *its own cause*, but as the cause of that of which it is in truth but the *effect*, namely, the peculiar habit of the plant, that which makes it one particular species and not another. It has sometimes happened, rather unfortunately for the truth, that those who have attempted to generalise in those matters of natural science where much remains unknown, have been but lame logicians; and though their confounding of causes and effects, in these matters, can do little or no moral harm, it is a stumbling block in the way of knowledge.

It cannot be too plainly or too frequently put, that the character of a plant or an animal, whether we call it generic, specific, or any thing else, is purely and wholly *matter of observation ;* and if we venture to add one word more than what that observation will bear out, we must be wrong, inasmuch as there is but one truth, and all else is error. If we find that certain parts of the character are changed by one mode of treatment, and not by another, we are warranted to conclude that so much of the character as has been changed depends upon that mode of treatment; and if we find a change taking place in nature, precisely similar to that which we effect by artificial treatment, we may conclude that the natural circumstances have been similar to our artificial ones. By thus experimenting, in as far as we can subject the living subject to experiment, we question nature by the test of art, and regulate future art by the knowledge of nature; and thus bring to living nature a portion at least of that inductive philosophy which has worked so many wonders for us in the study and use of dead matter ; but if we invert the order of nature, and call the final result, of which we can know nothing more than the simple fact of its having taken place, its own antecedent or cause, there is an end of all philosophy—of all sense and meaning.

ADIANTUM. A genus of plants belonging to the *Acotyledonous* or cellular order of vegetables; and to the natural family of *Filices*, the fern tribe. The name is derived from the Greek word ἀδιαντος, dry, because the plants are of such a nature that they cannot easily be made wet.

Generic characters : Clusters of capsules, oblong or roundish, with a membranaceous covering arising from distinct portions of the margin of the frond, which is folded back.

Upwards of sixty or seventy species have been discovered in different parts of the world—in Europe, North and South America, the West Indies, New Holland, &c.

Adiantum Capilli Veneris, or Venus's Hair, is an elegant fern, which, with its five green fronds, contributes not a little to adorn the dripping rocks and caves in various parts of Europe. It is rare in Britain, but very common in moist shady places in the south of Europe. Dr. Hooker has frequently noticed it lining the inside of wells with a "tapestry of the tenderest green." It has been found growing at Baguères in water of the temperature of 105° of Fahrenheit's thermometer. Its fronds or leaves are from six to twelve inches in length, and retain their green colour even when dried: hence they have a fine appearance in a herbarium. The plant possesses demulcent and mucilaginous properties.

Adiantum pedatum, another species, is common in France, and is employed extensively on account of its astringent pectoral qualities.

Both these species of adiantum, but especially the latter, are used for the preparation of a pectoral syrup, which has received the name of capillaire. The syrup is made with honey and orange-flower water, and is administered as a lenitive in coughs and catarrhs.

The other species of the genus are not put to any particular use.

ADIPOCIRE (Fat Wax). A substance, in its external or natural history properties, apparently intermediate between the two from which the name is formed.

The chemical properties of adipocire, or the species of chemical action by which it is produced, do not fall within the scope of natural history; but we may briefly notice the circumstances under which it is formed. If animal matter is left on the surface of the ground, or otherwise freely exposed to the atmosphere, no adipocire results; neither is there any formed when the animal matter is in small quantity, and not deep below the surface, in ground which is moderately warm, and not very moist. But when the quantity of animal matter is great, and the depth considerable, it not only forms in the situations that have been mentioned, but, after the lapse of several years, becomes partially transparent, and of a granulated texture approaching to crystalline. This was the case in the burial ground at the church of the Innocents in Paris, where the substance was first noticed, in the year 1787, when the matter of that common place of inhumation was removed. Bodies in vast numbers had there been thrown into pits, thirty feet deep, and twenty in each of their other dimensions. Those near the surface tainted the air very much, which was the cause of the removal; but when they had been heaped to a considerable thickness, the middle strata were converted into adipocire in about three years; and such as were lower down, and had remained as long as from thirty to forty years, had become granular and semi-transparent. When water is present, the change takes place much more rapidly, and at a less depth below the surface; so that the allegation which Shakspeare puts into the mouth of the grave-digger, that "your water is a sore consumer of your dead body," is literally true, and helps to prove the wonderful extent to which that great man had carried his observations. In the warm and dry regions of the globe, bodies do not change into adipocire; and in the cold and humid ones, the change takes place much more generally than in the temperate. It is so common in Iceland that large masses are laid upon the beams of the churches, and kept there for medicinal purposes, nearly the same as those to which the stearine of whales' fat (improperly called spermaceti) used to be applied in this country. How soon it forms in that part of the world has not been accurately ascertained; but as the climate is very rainy, and the soil in consequence very moist, it is probably formed with considerable rapidity. The battle of Culloden was fought in 1746, and the greatest carnage being on a wet and boggy piece of ground, a number of bodies were buried in a common grave there, at a very small depth below the surface. On opening the green hillock over that common grave, in the early part of the present century, and in quest of very different memorials of the battle, large pieces of adipocire were found, and they were almost the only animal remains that were met with, the bones having decayed more than in the drier soil.

The forming of adipocire in the soft parts of animals, or rather the conversion of them into it, indiscriminately and without regard to their appearance and texture while alive, is a curious fact in the animal structure. It is effected wholly by the chemical properties of the parts themselves, and the process is impeded or prevented by external agents; for water only more completely excludes the air than earth does, and cold is merely a less active degree of heat. In substance it must be the same as the parts of the living animal; and as the mass is uniform, it shows that the soft parts, when left to their own action, have all a tendency to pass into the same substance. That tendency must be in them while the animal is alive, though it is then counteracted by the functions of life. It appears to be, or rather indeed it certainly is, the same action by which fat is accumulated; and the gradation from oil and soft fat, through firm fat, stearine, and that half-fatty, half cartilaginous, substance which forms the humps of camels and other humped animals, and collects in the dew-laps of hill cattle when they fatten in the autumn, is a very near approach to adipocire. In the living animal, the fat, whatever may be its consistency, is merely food, assimilated but not organised, stored up against the period of want, whether that period be one of hybernation, or winter repose, or merely one of the absence of food while traversing the desert, or otherwise passing from one feeding ground to another. In some of these cases, as in that of the spermaceti whales, the store thus accumulated appears to be so completely without the range of organic action, that it granulates something in the same manner as adipocire; and in others, as the humps of the camel, it has a slight, though a very slight, trace of organisation. But, whatever may be its structure, it appears to be available for the repair of all the parts of the organisation, as long as the powers of life retain their energy; for when circumstances render it necessary, all the accumulations, even to the hump of the camel, are taken into the system.

From what has been said of the change of the surplus food into fat, the fat into organic structures, and these again (with the exception of earthy salts and coagulated albumen) into adipocire, it appears that the living body is not formed immediately from, or immediately convertible into, the dust; but that there is an intermediate process, that of *assimilation*, by which the food of animals is turned into animal matter, before it becomes, by another process, which is usually called *secretion*, a part of the living animal. It is highly probable that in the last of these processes, the aliment passes through the state of air or gas; and that when the organic structure returns into mere matter, without first becoming adipocire, it again returns through the state of gas. It is matter of common remark, that church-yards do not accumulate soil in proportion to the inhumations that take place in them; and (the dust of bones excepted) it will be found that the mould which is there, is wholly vegetable or mineral, from other sources. The coagulated albumen, which is not the same as boiled white of egg, (and that is an assimilated substance, though not organised till the egg is hatched,) appears to be neither animal nor vegetable, but a sort of mineral matter,—an armour which the living body puts on against the influence of the atmosphere. The earth of bones belongs to the same class of substances, and the bones, like the epidermis and its appendages, act no part in those functions in which animal life may be said to be exclusively displayed.

What may be termed "the working structures" of vegetables do not, like those of animals, pass into adipocire, but into mould when dry, and into peat when wet, and ultimately into coal,—for though the probability be that amber and jet are resins, yet these are not originally working structures, they are products.

This difference of the *destiny*, as we may call it, of the organised structures of animals and vegetables, is a very important point in physiology, as showing that there is a distinct line between these two kingdoms of nature. When they are dead, external causes can dispose of both in the same manner, namely, earth to earth, water to water, and air to air; but when we exclude those causes, each turns to a different substance—the animal to adipocire, the vegetable to mould or coal; and the final state of each bears a very considerable resemblance to that which it had when first taken into the system, and before it became part of the organic structure.

The views which this subject opens up are too vast for a single article, or even for a work intended and adapted for popular reading; but they are especially worthy the attention of those learned persons who, of late years, have lingered so long upon the twilight boundary between the animal and the vegetable kingdom, as to be in some danger of confounding the one with the other, and thereby jumbling the whole system of nature into a chaos. See the articles ANIMAL PHYSIOLOGY, VEGETABLE PHYSIOLOGY, and the various references from them.

ADIPOSE TISSUE. The cellular membrane in which is deposited the fat (*adeps*) in animals. A knowledge of the structure, and especially of the functions of the animal frame, is highly necessary, not only in order to the proper understanding of the anatomy and physiology of animals, but to that of some of the most curious parts of their economy in the state of nature, and some of their most valuable domestic uses. In various animals it is variously disposed, and endowed with different degrees of power in depositing or secreting fatty matter; but in general it is found under the skin, accompanying the muscles on their general surfaces, and also on those of their fasciculi or bundles of fibres, and also covering much of the internal parts, whether their textures be muscular or not. In many instances it appears to pervade the bones, and to produce marrow in the larger tubes, and fatty or oily matter in the more minute cells; and the same surfaces by which it is secreted, or, at all events, deposited, appear to have the powers of absorbing it again, even from the bones of the animals, when, from any cause, that becomes necessary for the preservation of their existence. "Thy bones are marrowless;" this applies not only to the supposed "ghost," but to that state of emaciation, not inaptly termed "ghost-like," to which the bodies of men and other animals are sometimes reduced, by disease or otherwise. The walls of the cells of this tissue are membranous, and do not, in any instance, appear to have the power of muscular contraction. It does not appear to invest directly any part of the nervous system, neither does it appear to contain any nervous fibres in itself; at least it can be distended, and even divided, without any painful feeling. The distension of which it admits is often very great; and the quantity of fat accumulated bears so great a proportion to the membranous matter in which it is contained, that the whole accumulation has the appearance of being an uninterrupted mass of fat; but such is not the case; for, upon burning a portion of the fat of any animal, the peculiar smell of animal matter is invariably given out, unless that fat has been previously freed from every portion of the cellular tissue, by some process of clarification or fining; not only so, but the entire fat of any species of animal gives out, when burned, the peculiar odour of the burning flesh of that animal, if it has such an odour, as any one may observe by comparing the smell of whale oil and of candles made from the fat of different animals in the unrefined state. When, however, the adipose tissue is wholly removed, no animal odour is given out in burning the pure fat; so that the fat cannot in itself be considered as an organised animal substance, but merely as one in a state of preparation; bearing some analogy to the pulp of fruits, the albumen of seeds, the substance in the thickened hybernacula of buds and roots, and partially also to the parenchyma or pulp in the cells of succulent leaves. As it is different both from the portion of the food of animals which is supposed to be taken directly into the system by absorption, and to that which is assimilated as chyle, it must be considered as the result of some sort of secretion; but as it wants the proper indication of animal matter strictly so called, it must be regarded as the product of a first secretion, to which a second must succeed before the matter secreted by the cells of this tissue can form part of what may be regarded as the working structures in the animal system. It would of course be inaccurate to call any one part of an animal the vegetable part; but the function performed by this tissue appears to be somewhat analagous to the functions performed by the cellular tissues of vegetables, if not in product, at least in manner of action.

The varieties of action and their results are so different in the adipose tissues of different animals, are so many, and some of them are so very important both to the capturer of wild animals and to the cultivator of domestic ones, that they cannot be brought within the compass of a single article. Some of them will be found treated of under the article FAT, and the references from that article; others will be found in the descriptions of the genera or species.

ADJUTANT BIRD. The popular English name of several tropical birds of large size, of very peculiar shape, and, generally speaking, familiar manners. They belong to the order *Grallidæ*, and the genus *Ciconia*, and are in fact storks, resembling in their manners the common storks, which are far from rare in Holland and other parts of the Continent; and these live in the towns, perch on the house-tops, and breed in boxes placed for their accommodation; but the European species retire to more tropical latitudes in the winter, and the whole genus are migratory.

Though classed as wading birds, the storks generally, and the adjutant birds in particular, do not find the greater part of their food immediately *in* the waters; but rather upon those places of the land from which the water has retired, though they prefer marshy situations, migrate from places which become dry and parched, and return with the rainy season.

The use of these birds in tropical countries, where the alternations of drought and humidity are in extremes, is very great; and thus they form a characteristic as well as a peculiar feature of those countries. They are voracious feeders, and so daring in their habits, that though they do not exactly take the prey out of the lion's mouth, they seize it in the immediate vicinity of any animal, even of man himself. They feed upon reptiles, fishes, small quadrupeds, occasionally birds, and, in general, all manner of offal and animal subtances; but they do not attack and kill any large animals of the warm-blooded classes.

When the drought sets in, and reptiles either perish or betake themselves to the earth, in which many of them pass that season in a state of torpor or inactivity, the adjutants quit the country, migrating to other parts of the world, if there are not places adapted for them within the range of the country, or otherwise resorting to the lower banks and embouchures of large rivers, and the mud flats which are usually found in such places. There they appear in flocks, after the habit of many of our British birds, which resort to the shores when the state of the weather drives them from the interior; and, while they remain in these places, they feed chiefly upon the young of crocodiles, alligators, turtles, and other large aquatic reptiles, which deposit their eggs in the banks to be hatched by the heat of the sun. In tropical countries the season of drought is the winter or sterile season on land; but it is the time at which the shores of the sea are more than usually productive, as those parts from which the water partially retires act as hot-beds; and, in the time of the dew towards evening, there is an absolute rush of living creatures from their birth-places in the mud to their future abode in the water. At the same time the mature ones come on shore to deposit their eggs. Thus, while the land is barren, these large birds feed chiefly on the margins of the waters; and when the rain sets in, or rather a little before it, they resort to the interior. They are found in the tropical parts of Asia, Africa, and America, though with some specific differences.

The whole race of the storks are, from the structure of their feet, marching birds, rather than runners. Their long journeys are all performed on the wing; and when they advance a considerable way on foot, they do it with the body erect and the wings elevated; though they strut rather majestically, with the wings close. Their feet have the front toes rather long, and united by membranes at their bases; and though the hind toe is articulated on the tarsus, the lower extremity of which forms an elastic knob, that toe is of sufficient length for the first joint to rest on the ground. In flying they do not extend the neck, but fold it back on the shoulders, though they project the feet behind. They are social in their breeding places, and the sexes have little difference in appearance; but the young of the first year have the plumage much more mottled than that of the mature birds. The eggs are two, three, or four, of a dull white colour, and very much elongated. The pairs are much attached to each other, and to their young; and the same birds are said to return annually to the same places, in all their migrations, the several colonies joining as they leave the country, and parting for their usual haunts on their arrival.

Indian Adjutant.

THE INDIAN ADJUTANT (*Ciconia argala*). This bird is ash-coloured, except the belly, and part of the scapulares and the wing coverts, which are white. The head and neck are naked, except a few straggling hairs; and the feathers of the breast are long and pendulous; the bill is very large, and gullet capable of vast extension, so that the bird could easily swallow entire an animal as large as a common wild rabbit. The craw is also very extensile, and hangs like a pouch in front of the breast. The bird altogether is of large size,—measuring nearly six feet in height when it stands, and seven when it stretches the neck; and the wings from tip to tip measure little less than fifteen feet. From the dimensions of their gullets, they have been properly called "wide throats," and also "bone takers," as they swallow animals and parts of animals, bones and all. They do not, however, "grind" the bones with their bills, as has sometimes been stated; and neither the tomia, or cutting edges of the bill, nor the muscles by which they are moved, are adapted for such a purpose, the bones being returned by the gape, after all the digestible part has been removed by the action of the gastric juice.

They are uncouth, and almost, as one would say, "ugly" birds. Their colour is dingy; and the bare head and neck, with the ruff of produced feathers, make them look ragged, as if the plumage of those parts were torn off. Their noise, too, is hoarse and grating, and resembles the roaring of a beast of prey. The length and strength of their legs, however, enable them to march with long strides, and in a stately manner; and when on the wing they appear very large, though they have the swinging flight which is characteristic of all the tribe of herons, cranes, and storks.

In India, they haunt the jungles of the Lower Ganges in the dry season; and as the rains set in they migrate up the valley of the river, being almost as common in Calcutta and the other towns as sparrows are in any part of England. They stand upon the tops of the buildings, walk the streets, and are especially abundant in those parts of the towns which are inhabited by the Hindoos, who pay little attention to cleanliness. Even in the European parts of these towns, there is much food for the adjutants. Animal substances will not keep, especially in the rainy weather, as they do in our northern latitudes; and as the servants are chiefly Hindoos, and their religious prejudices prevent them from eating animal food, the broken meat is thrown into the streets, where it is soon picked up by the adjutants during the day, as well as by the jackalls and dogs during the night. But though the birds are great consumers of offal and carrion, and, in a country where animal substances so soon putrify and taint the air, they are of great service in so doing, yet they do not wholly confine themselves to that description of food. They eat reptiles, many species of which are peculiarly annoying and offensive in those hot countries; they also eat birds, which they sometimes capture in their flight, and they make prize of the smaller quadrupeds, sometimes of domestic cats, the bodies of which, as also those of land tortoises, have been found entire in their craws. The veneration in which these reptile-destroying birds have always been held by rude nations is one of the most conclusive proofs of their value; and though the genius of the Hindoo's religion does not lead him directly to deify the adjutant, as the inhabitants of ancient Egypt did the ibis, yet he regards it as something sacred, and under the especial protection of Heaven. According to the doctrine of metempsychosis, which forms part of the Hindoo faith, these birds are temporary residences for the souls of holy Bramins; and therefore they are not only spared with religious veneration, but considered as invulnerable, in consequence of the sanctity of that *caste*, of whose souls they are, for the time, the special receptacle. The Mussulmans and Christians of the same regions spare it on account of its less saintly and elevated but more useful character of scavenger; and thus, what with religious, what with animal respect, the bird ranges the wide plains and valleys of India at its pleasure, contributing much to the picturesque effect, though little to the beauty of the places which it haunts. When the birds are in a state of quietude on the housetops, they seem as if they were parts of the architecture; and, in the season, an Indian city would look as unlike itself without adjutants, as an English one without chimneys.

But though when there is "nothing going," the adjutants remain at rest on their watch-towers, they keep a vigilant look out, so that offal cannot be cast into the streets, or one of the animals upon which they prey cannot make its appearance, without the bird instantly being on the spot. We have no knowledge of their sense of smell; and indeed the action of that sense in all the tropical birds which feed upon carrion and other tainted substances is a matter of obscurity; but they are exceedingly quick-sighted; and whether when inland or on the shores, few objects of the size or aspect of their prey can stir without their notice. As they partake something of the taste of vultures in the readiness with which they find, and the rapacity with which they devour, carrion, they also agree with those birds in their cowardly nature, and the indisposition they have to attack even a small animal; if it shows an inclination to fight, they scream, or rather roar, elevate their wings, and open their great bills as if they would swallow all before them; but a child may drive them off with a switch; and they avoid the menace of the smallest dog, or even that of a brood hen, though they hesitate not to swallow the chickens if they can do it in the absence of the dam. The quietude of cats, unless when hunting, and their crouching and lurking habit, render them much more manageable prey for these birds, which can pounce upon and swallow them in an instant.

There is another species, of a dull blackish-green colour clouded with greyish ash, and having greenish metallic reflections on the secondary quills, and reddish brown spots on the middle coverts. It is found in Sumatra and Java, and has been named *Ciconia Javanica* by Dr. Horsfield; but its manners, in as far as they may be different from the rest of the genus, are not much known.

The African Adjutant (*Ciconia marabou*).—This species is found on the shores and along the banks of the larger rivers of tropical Africa, shifting its locality with the season, as is the case with the others. This one has been sometimes confounded with the former, from which it does not appear greatly to differ either in aspect or in habits. It is said to be without the white in the wings, and to have the feathers on the breast less produced. It is equally cowardly and voracious, and from the latter propensity it needs no taming, as it will-readily come into towns, or even into houses, if it can get food. Like the others, it swallows animals of considerable size, bones and all; but it does not break the bones, indeed the texture of the bill is not suited for such a purpose. The following account of one in a state of domestication, in the possession of a native chief near Sierra Leone, is in substance from Mr. Smeathman, to whom we are indebted for many other particulars in the Natural History of Africa. The specimen in question stood about five feet in height. It used to be fed in the great hall of the chief's habitation, where he and his guests dined; and so punctual was it to the dinner hour, that it used to plant itself behind his chair before the company arrived. When the dinner was served, it marched about; and if a share, and a pretty large share, was not given it, it made no scruple in helping itself, not to trifles, but substantial fare, for a roast fowl was only a single mouthful. It required, indeed, a good deal of restraint; and the servants had to carry switches for the purpose of beating it away from the meat, and though beaten at one point, it would immediately renew the attempt at another. It is, indeed, a very general habit with those birds which can be tamed through the medium of their rapacious appetites—the chief way, indeed, in which birds can be tamed—to return instantly to that food which they have been beaten for attempting to purloin. They cannot be shamed as a dog can be, neither can they be permanently frightened. The one in question being fed without any other labour than that of swallowing, which is a short and easy process with such width of throat, was accustomed to fly about during the day, or to perch in a grove of cotton trees at the distance of nearly two miles. But, even from that distance, it could see when dinner was serving; and though it did not begin its flight till the said dishes were carried through the court, it was in the hall before all the dinner was in order. Smeathman farther describes these birds as standing full seven feet in height, and as appearing like canoes on the smooth water, when moving along the banks in lines with extended wings. At other times, when feeding on the shores, they had the appearance of human beings engaged in picking up shell-fish, which is no uncommon employment of the women and children in tropical countries.

American Adjutant (*Ciconia maguari*).—This is a much smaller species than the Asiatic or the African, being only about half the length, and rather less than half as much in the extent of the wings. The neck and head are feathered, except a small portion round the eyes. The general plumage in the mature state is white, with the quills and upper tail coverts dusky green inclining to black. It bears considerable resemblance to the common white stork of the old continent, only the bill is ash-coloured instead of red, as in that. It is found chiefly in the central parts of South America, migrating by the valley of La Plata from the central heights between the sources of that river and the branches of the Amazon, which are inundated during the rains, and the marshy shores in the southern parts of the Pampas. It has sometimes been confounded with the *Jaribus*, which inhabit the marshy grounds nearer the shores of the Caribbean Sea. See articles Ciconia and Stork.

ADNA (Leach, Lamarck). This genus of shells was constituted by Dr. Leach, and has been adopted by Lamarck, and some other naturalists; it nearly approximates to the balani. The shell is cup-shaped, sessile, composed of one part, with a lozenge-shaped aperture, closed by four valves or detached pieces; it is slightly ribbed externally; the operculum transversely streaked; and it is of a fine rose colour. The English adna is found on the coast of Devonshire, attached particularly to the *Coryophillia Anglica*.

ADONIS (Linnæus). A showy genus of plants comprising ten species of annual and perennial hardy herbs, cultivated for their flowers. Linnæan class and order, *Polyandria Polygynia;* Natural order, *Ranunculaceæ.* From the natural order, however, it is distinguishable by wanting the nectariferous claw at the base of each petal; and from the other genera by the many dry sharp pointed grains of its fruit. The *A. autumnalis* is found, sometimes in great plenty, in corn-fields, and called by country people the pheasant's eye.

ADOXA. A name applied to a genus of plants belonging to the natural family *Saxifrageæ* or *Saxifrage Tribe;* and to the class *Octandria*, order *Tetragynia;* of the Linnæan system. The name is derived from two Greek words, α, without, and δοξα, glory, in reference to the humble and unassuming growth of the plant. Generic characters: calyx, divided into five segments; corolla, inserted above the germen, and divided into four or five segments; fruit, a four or five celled berry. The only known species is the *Adoxa Moschatellina*, or *Tuberous Moschatell*, a native of Great Britain, found in woods and shady places, and sometimes even growing on the tops of the Highland mountains. It is a very delicate plant. The flowers in the evening are said to emit a musky smell.

ADULARIA. This mineral, which is better known by lapidaries as *moonstone*, was first described by Professor Pini, of Milan. He named it Adularia Felspar, in the belief that the mountain on which he had collected it was named *Adula;* but the truth is, the mountain of Adula where he procured it is not situated near St. Gothard, but in the Grisons.

The variety of adularia which exhibits a bluish pearly light is much valued by jewellers. It is cut in a low oval form, and in such a manner as to present the pearly spot in the centre of the gem; it is set in rings or brooches, with rubies and emeralds, with which it forms an agreeable contrast. Sometimes ring-stones of it are set round with diamonds, and its pearly light forms a striking and agreeable contrast with the lustre and colours of that gem. The finest specimens are brought from Ceylon; but even there, perfect stones are rare.

Another variety of adularia, found in Siberia, is known to jewellers under the name of *sunstone.* It is of a yellowish-grey colour, and numberless golden spots appear distributed throughout its whole substance. The decomposition of light which produces this singular optical illusion arises either from minute fissures, or the irregular cleavage of the mineral.

ÆCIDIUM (Persoon). A genus of plants belonging to the natural family of *Fungi*, or the mush-

ÆCIDIUM CANCELLATUM; *a*, a leaf upon which it is seen growing of the natural size; *b*, peridia, magnified.

room tribe, and to the class *Cryptogamia* of Linnæus. This fungus consists of small membranous sacs or protuberances, which are found parasitic on the leaves, bark, fruit, &c., of several plants; such as the fir, violet, gooseberry, barberry, dandelion, hawthorn, nettle, primrose, &c. The membrane forming the sac has received the name of Peridium. It pierces the bark or epidermis of the leaves, and encloses very minute dust-like seeds or sporles, which are ultimately discharged by an opening in its side or summit. In consequence of the seeds being contained in a membrane, the genus has been referred to a division of the *fungi* which has been denominated Angiocarpi. There are upwards of thirty known species of the genus, and they receive their names from the plants on which they are found. Link has divided this genus into three sub-genera, the *Æcidium*, properly so called, the *Ræstelia* and *Peridernium.* The *Æ. cancellatum* here represented, belongs to the second of those divisions. It is often found on the leaves of pear trees. To the third division belongs the *Æcidium pini*, remarkable for being the largest species, and for growing, not upon the leaves, but upon the bark of the pine tree. They vary in colour; the species which grow on the gooseberry and barberry leaves are red, that found on the Scotch fir is yellow, and that on the meadow-rue bright orange. The Æcidia cause considerable deformities in the plants on which they grow, and some of them are decidedly injurious. The gooseberry æcidium is said frequently to destroy the young fruit of that plant; and the species found on the barberry has been stated, though perhaps erroneously, to be hurtful to corn growing near it.

ÆGERIEDÆ. A family of insects belonging to the order *Lepidoptera*, or those which have the wings covered with scales, or more strictly speaking with minute feathers, and to the division of that order which are *crepuscular*, that is who seek their food, or otherwise appear, chiefly in the twilight. This family are less crepuscular in their habits than most of the division; for though they do not come abroad at midday they are seldom found on the wing after night begins to close in. They bear fully as much resemblance to bees, hornets, or wasps as to the moths, or even to the *Sphingidæ* with which they were confounded by Linnæus; but though in appearance they resemble those insects, they have none of their habits, and indeed none of the characters of the order to which these belong. In the caterpillar state they prey upon the smaller and more succulent twigs of plants, more especially of the currant and other fruit-bearing bushes, and hence they are some annoyance to gardeners. They are popularly called hornets, or sphynges, and another epithet is usually added, expressive of the better-known insect which they most nearly resemble, as the "bee," the "wasp," and that which is troublesome to growers of small fruit is called the "currant hornet sphynx," from the plant which it chiefly infests. The last species (*Æ. tipuliformis*) is the most common in Britain.

They are active swift-flying insects, and rest with the wings stretched out horizontally, and the brush which terminates their abdomen spread out. One genus (*Ægeria*) have the antennæ as long as the body; the other genus (*Trochilium*) have theirs short and stout. Of the first genus we have two species which are indigenous to this country. Several other species are found on the continent, and also in India, South America, and New Holland.

The genus Trochilium consists of several species, of which three are British, which are found to inhabit the poplar and lime trees about the end of June. The caterpillar of the hornet moth (*T. apiformis*) is whitish, with an obscure line down the back; head large and brown, and it feeds on the wood and shoots of the above trees. This beautiful and interesting insect is found occasionally very early in the morning on lime trees, near Wanstead in Kent.

The second species (*T. Craboniformis*), the lunar hornet moth, inhabits the poplar and sallow. The Caterpillar is of a whitish colour, with a brown spot on several of the segments near the legs; it feeds under the bark of the sallow. Stephens saw them in profusion flying heavily along on the south-west border of Dareuth Wood in Kent, in the beginning of July 1817.

ÆGIPHILA (Jussieu). A family consisting of seven species of hot-house ever-green shrubs, indigenous to the West India islands. Linnæan class and order, *Tetrandria Monogynia.* Natural order, *Verbenaceæ.* Generic character: calyx of four teeth; corolla, the tube longer than the calyx, the limb in four open divisions, carrying four equal projecting stamens. Style deeply divided. Fruit, a pod, or capsule of four places, and seeds.

ÆSCHYNOMENE. Hot-house annuals, and trees mostly natives of warm climates. Linnæan class and order, *Diadelphia Decandria.* Natural order, *Leguminosa.* There are eleven species known, some of them have exceedingly splendid flowers.

ÆSCULUS (The Horse Chestnut). A term derived from the Latin word *esca*, food; and applied to a genus of plants belonging to the natural family *Hippocastaneæ*, and to the class *Heptandria*, order *Monogynia*, of the Linnæan system.

Generic characters: calyx, bell-shaped; petals, four or five, with an ovate limb; stamens, having their filaments curved inwards; capsules, rough and prickly; leaflets, nearly sessile. The five species known are hardy trees, remarkable in general for the beauty of their foliage and flowers. Of these the æsculus hippocastanum, or common horse-chestnut, is familiar to every one. The native country of this tree is yet imperfectly known. It is generally said to be indigenous in the northern parts of India, but it has not been found by the most recent travellers in those parts. It is said to have been brought to Constantinople in 1550, and to have been afterwards introduced by Clusius into Austria, whence it has been spread over Europe, and has been long cultivated, and thrives well in Britain. It is clothed with dense foliage, and sends out branches to a great width. Its large cones of white flowers, spotted with red, render it very ornamental in avenues and pleasure-grounds. But it is never cultivated for the purpose of furnishing timber. The young branches are said to grow with amazing rapidity, acquiring an inch in length in the course of twenty-four hours. The fruit, dried and powdered, has been used as a medicinal snuff for the cure of headach and sore eyes. A decoction or infusion of the fruit has also been drawn up the nostrils for a similar purpose. The seeds are large and farinaceous, and have been used as food for animals. The bark is bitter and astringent, and has been used, chiefly on the Continent, as a substitute for Peruvian bark. It has been used successfully in intermittent and continued fever, as well as mortification. The bark may be given in the form of powder, in doses of thirty or sixty grains; or in the form of extract, in doses of five or eight grains. According to the French chemist Pelletier, it does not contain an active alkaline principle, like the Peruvian bark. Starch has been obtained in considerable quantity from the horse-chestnut. The tree also contains so much potass that it may be used in the place of soap.

The horse-chestnut thrives best in rich light earth, but it will grow even in sandy or gravelly soil. A variety is cultivated with striped leaves.

Horse Chestnut (*ÆsculusHippocastanum*). *a*, Flower, showing the seven stamens and single pistil; *b*, the fruit.

Æsculus Ohioensis. The American horse-chestnut, or Ohio buck-eye, is found abundantly on the banks of the Ohio, between Pittsburgh and Marietta. It is a tree of moderate growth, generally attaining the height of ten or twelve feet; sometimes, however, it is thirty or thirty-five feet high, with a diameter of twelve or fifteen inches. The leaves are large, being nine or ten inches long and six or eight broad. The flowers are very numerous, of a white colour, and grow in clusters. The fruit is only half the size of the common chesnut. The *æsculus glabra*, or smooth-leaved horse-chestnut, and the *æsculus pallida*, or pale-flowered horse-chestnut, are also natives of North America, and are found in Virginia, Pennsylvania, and Kentucky. The only other species, the *æsculus rubicunda*, or carnea, ruddy horse-chestnut, is distinguished from the rest by its beautiful scarlet flowers, and is said by some to be a native of North America, but this has not been accurately ascertained.

An allied genus, which has received the name of *Pavia*, and the species of which are very common in America, where they are known under the name of buck-eye, has often been confounded with the horse-chestnut. The smoothness of the capsules, or seed-vessels of the pavia, is, however, an excellent distinguishing character.

ÆSTIVATION, or *Præfloration*, is a term illustrative of the mode in which the various parts of a flower are arranged when in bud or previous to expansion. Thus we have the *imbricated æstivation*, when the divisions of the corolla, called petals, cover each other partially, as in the rose, pear, and cherry, before expansion; and the *puckered æstivation*, when the petals are folded in different directions, as in the poppy. The æstivation is generally similar in plants belonging to the same natural family.

ÆTEA (Lamouroux). A polypidom of the first order, and first class, which contains all such as are celluliferous, and whose polypi are found in shelly or non-irritable cells. This genus appears to unite the first order with the second, having a rampant stem from which the cells issue; but it nevertheless differs essentially in the form of its undulated stem, which is branched and knotted at stated distances, and also in the form of its cells; it is therefore more properly an intermediate species. The cells are solitary, opaque, tubular, in the form of clubs, and arched, opening at the side. At present, only one species of this genus is known; and it is very common on marine plants in the European seas. They embellish these vegetables by the pearly whiteness of their cells, which forms a beautiful contrast with the brilliant red hue of the plocamis, on which the aëtea anguina is frequently found; they appear like many clefted leaves of red coral, delicately clothed on all parts with fine hairs of a silvery white lustre. They are found both in the European and Australian seas.

ÆTHIONEMA (R. Brown). A genus consisting of four species of European annual herbs. Linnæan class and order, *Tetradynamia*. Natural order, *Cruciferæ*. Generic character: calyx, petals unequal; filaments longer than the stamens, often united; silicule hollowed, formed of two keel-like valves, two-celled, containing one or two seeds.

ÆTHUSA. A genus of plants belonging to the umbelliferous family, and containing a few species; one of which, the *Æthusa Cynapium*, common fool's parsley, lesser hemlock, or dog-poison, is a native of Great Britain.

The name Æthusa is derived from the Greek word *aitho*, to burn, on account of the acrid properties of the plant. The *Æthusa Cynapium* is common in fields and in gardens. It has a nauseous smell, and possesses deleterious properties. From being gathered in place of garden parsley, or along with it, it has given rise to serious consequences. It can, however, be easily distinguished, when in flower, from parsley and all umbelliferous plants, by its involucrum, which is formed by three long drooping leaves, all on one side. When not in flower, the dark glistening appearance of the under surface of the leaves, and the nauseous smell they exhale, are sufficient to distinguish it from parsley. The plant is said to contain a peculiar alkali, called cynopia.

In animals this plant causes convulsions, stupor, and death, in a short time. In man, the symptoms produced in the fatal cases have been sickness, vomiting, headach, giddiness, a tendency to sleep, a sensation of heat in the stomach and throat, with difficulty of breathing and numbness of the limbs.

AFFECTIONS OF ANIMALS. Natural history affords few subjects more interesting than the one we are now about to examine. No one can attend much to animals without seeing in them instances of affections, which, as far as they go, would do honour to the human race. The dog, the elephant, the horse, all animals that have been domesticated, afford innumerable instances of affection equally strong and enduring, and far more apparently free from selfishness than that which is shown by the most devoted of mankind; and there is not the least doubt that, if the method of doing it were known, and there were sufficient inducements to the practice of it, all animals could be tamed, and made to render to man the same complete and ready obedience as is rendered by the spaniel. Instances might very easily be brought from the whole of the animated creation. The common seal has sometimes been made a very attached and sportive companion, and taught to keep watch like a dog in the absence of its masters; reptiles and fishes have come to the whistle of their trainers, not merely to be fed, but to be fondled, and every schoolboy has heard of the captive and his companion spider. Similar affections have been observed between animal and animal, not only in those of the same species, but where, in general, and in accordance with the common habit, the one species regularly destroys, or makes prey of, the other. The cat and the mouse, the hawk and the sparrow, and other animals that have what is usually called the same natural antipathy, have lived together in the same cage, with the most perfect harmony. The attachments which animals in the wild state show for each other are every way as striking, more so, perhaps, because they take place without the application of human instruction. The affection of all animals, the females especially, for their young, when it is the habit of the species that the young shall be for some time dependent on the mother for food or for protection; the affection for each other of the sexes, in such as remain together for life, and which are just as striking all the year round as during the breeding-time; the affections of gregarious animals for their own herd, and those of the analogous gregarious tribes for each other, are all very remarkable; and they may all perhaps be regarded as more pure and free from selfish considerations than the associations that are formed by the human race. The male eagle does not show his affection for the female, through summer sun and winter storm, because of the portion which she brought him at the time of their union; neither are her affections in any way bought or captivated by the certainty of a living or the pomp of an establishment.

The principles of those animal affections for each other, for different species, for certain places rather than others, though both in our judgment appear equally fitted for them, for mankind generally, or for apparently selected individuals of the human race, are all obscure and unknown to us farther than as we can infer them from the facts; and it is to be feared that we, in most instances, draw those inferences, as if we had been observing men and not the other animals.

There are some curious distinctions between the males of monogamous and polygamous animals, to which we can find fancied resemblances in the conduct of mankind. Animals, which associate in pairs only, seldom, if ever, fight battles of gallantry. Like good husbands and housewives they take care of the interests of their own family, and often keep intruders from that part of the country which they select as their abode; but they do not intermeddle with the domestic concerns of each other, or fight for mere gallantry: indeed they seldom fight at all. The lion and the eagle are professional butchers, but they are, in no sense of the word, soldiers of honour; they exert their great powers solely to kill, and kill solely to eat the slain. If, on the other hand, the males are polygamous, they are almost invariably pugnacious, some of them at all seasons, and all of them in the breeding season. Bulls, rams, cocks, grouse, and indeed all polygamous animals with which we are acquainted, are valorous in the season of excitement, even though, at other times, they seem the veriest cravens in the world. There is a trace, and a pretty obvious trace, of the same conduct in man, though upon that particular branch of the question it is not so expressly said that either the one or the other acts from the judgment of reason. Yet, in that affection of animals, they show as much conduct as in any other; and the stratagems to which they resort in their combats of gallantry with each other, show quite as much plan and purpose upon their part as any other of their habits.

That not the affections of animals merely, but the whole of their conduct and economy, are wonderful beyond our admiration, and perfectly beyond our imitating, must be admitted; but they are not more so than the economy of plants, or the properties of inorganic matter; and, were it not that we are unable to trace in the substances belonging to the vegetable or the mineral kingdom, any of those resemblances in form and in mode of action to the material part of ourselves which we can trace in animals, there is little doubt that we would also attribute reason to them, so prone are we to make ourselves the standard in all our judgments.

But, if we carefully examine the matter, we are, in all cases, able to discover, that the principles upon which an animal acts, even in those displays of its habits, whether in wild nature or under human training, to which we give the name of affections, are nothing more than the common principles of organic matter, namely, those of yielding wholly to present circumstances, without any relation to the past, or any assistance from it. Their lives pass away without leaving any trace or any lesson that can be useful to them as a guide upon future occasions, or transmitted from one generation to another. As it is most truly and emphatically said, "their memories perish;" for if the individual could profit by experience as man profits, it is not possible to doubt that the wisdom, which is transmissible from day to day, could not also be transmittable from generation to generation. Yet there is no instance of any one race of animals which is a jot wiser, or a jot more foolish, than in the times of its remotest ancestry. Under the same circumstances of climate, soil, seasons, food, weather, and all else by which an animal in a state of nature can be affected, the animal is similar in all ages, just as the plant or the mineral, under circumstances exactly the same, is exactly similar.

That it can be turned and tutored, even to the performance of those feats which we look upon as prodigies, is no proof of reason in the animal, but rather the reverse, because it shows the perfect readiness with which it obeys the circumstances in which it is placed. The training is not conducted upon the principles of reason, and yet the animals to which we are most ready to concede that "inferior degree of reason," are the very same species which we can train most easily and completely. That we can train some species more readily than others proves nothing in favour either of the reason or the superior tractability of the animals; it merely proves that we are better acquainted with their physical wants, to which their physical organisation is obedient. But, as the training is for our purposes, and not for any purpose formed by the trained animal, we must see, that, if the animal had reason and purpose, it would resist our training, and cease to obey those circumstances to which we have, from the knowledge of its habits, taught it obedience. If there were any experience of the past, and any interpretation of the future, in the animal, it would certainly rebel. If the horse, which had been driven and flogged in harness yesterday, pinched with hunger and pelted with rain, then shut up for the night in a close and pestilential cellar, with little to eat, and that little not the most wholesome, had any memory of that treatment—and if he had, he would remember that it began with the harnessing—he would resist to the death rather than be yoked again to-day. Horses do sometimes rebel; but it is momentary, like all their actions, and begins and ends with the peculiar circumstance or combination of circumstances which forms its cause.

Whether we consider the affections of animals as the result of chemical and mechanical principles applicable both to living matter and to dead, or as the result of reason and judgment on the part of the animals, we encounter difficulties of no ordinary kind. The physical theory puts an end to animal life altogether as a portion of creation which man can rationally know and usefully turn to account; and the hypothesis of reason not only shelters the animal from our knowledge and dominion, but reduces us to its level; to the peril, nay to the certain destruction, of moral obligation and eternal hope; for these are so linked together that the one of them cannot exist without the other.

But when we consider, as nature itself would point out to us, if we would keep silence till we have used our eyes, that the animal organisation merely stamps a new character upon matter—a character which varies with the species of organisation; and which, while it wants the operation of that part of the laws of the material creation which determines the powers of dead matter, becomes far more sensible to other parts of the same laws; then we have only to find out what these laws are, and how they operate, in order to bring the energies of animal life as completely within our knowledge and dominion as we do inanimate matter.

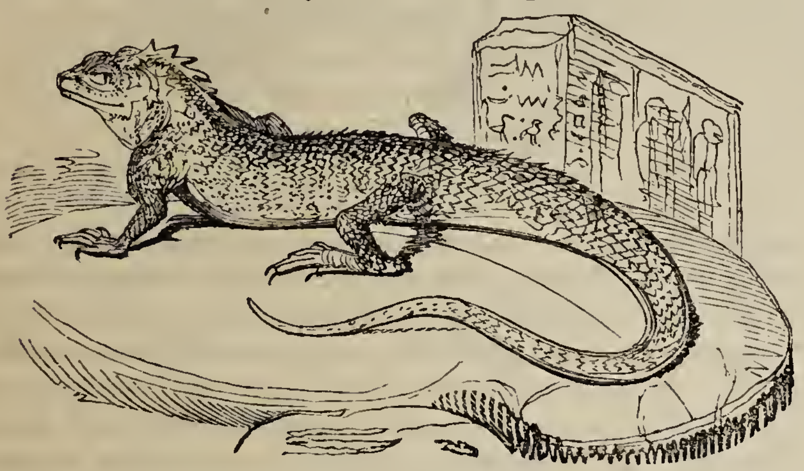
Viewing the subject in this light greatly extends the field both of study and of usefulness, makes them both wide as the world, and varied as all that it contains. At the same time it shows us that what has been already accomplished is a mere nothing compared with what yet remains to be done. Take the list of any of the classes of animals which have been seen and named, and their shapes, sizes, and colours in part described; and mark how very few have been turned to useful purposes, even as so much dead matter. Then turn to the few that have been domesticated, and their affections in part ascertained and turned to account, and mark what services they have rendered to man. The ox, the horse, the sheep, the dog, the rein-deer, the camel, the elephant: these and perhaps not as many more are the whole of the mammalia that have been so studied as to be turned to use *when living*; and yet they have borne a most important part, not only in the improvement of the soil, but in producing and maintaining the civilisation of man himself. But all animals have their peculiar affection, and those affections have only to be studied in order to their being added to the animals on the list of our useful servants.

But by thinking and judging of them as if they were human beings, reasoning from the past, forming plans for the future, and acting by other laws than those of organised matter, we mar the heritage which God has given us, neglect or destroy the servants which he has assigned us. Thus, we often have to toil when we might be superintending and admiring;

and because we elevate the animals to the rank of rational and reflective beings, we are often under the necessity of degrading ourselves to that of mere machines. Animals have no previously formed plans to be overturned, and no prejudices to be got the better of. The causes of their affections are all contemporaneous with the affection itself; and they are all physical and open to our knowledge; so that, if we can by any means bring them about, we can command the affection of the animal and turn it to use, as certainly as we can model clay, or kindle a fire, and melt a metal.

AFRICAN LILY (Agapanthus). A half-bulbous, stemmed, green-house, herbaceous perennial. Linnæan class and order, *Hexandria Monogynia.* Natural order, *Hemerocallideæ.* Generic character: calyx, petaloide and tubular at the base, funnel-shaped, in six divisions, somewhat irregular. Stamens six, declining. Style one. This is one of the most beautiful of the lily tribe. With a little protection during winter it succeeds well in the open air, if placed under a south wall; there are three species.

AGAMA, a very numerous genus of reptiles,



Helmeted Agama.

belonging to the order *Sauria* and the family *Iguana,*—to which the reader is referred for the more general characters. They have no common English name, and the local names given to the different species are neither very appropriate nor are they useful. They all come under the vulgar name of lizards, and so far as they were known in his time they belong to the genus *Lacerta* of Linnæus. Since then, enough has been added to their history to show that his arrangement was wrong, but not enough to put it to rights.

The whole history of reptiles is, indeed, in a very imperfect and even chaotic state; and as the discoveries are only additions of species or varieties, of whose habits and economy very little, if indeed any thing, is known, they tend to make more confusion. There are, in most large collections, many species that are not even named, while, of most of those that have names, the characters are founded on the mere shape of the parts, without any reference to their uses in the economy of the animals. This is unavoidable, inasmuch as we know by far too little of the relation between the structure and the habits of any one species to enable us to proceed by analogy.

In the other classes of vertebrated animals, the case is different. When we meet with a new species of the mammalia or the birds, we not only know where to place it in the system, but from its organic structure we can tell many of its habits, and generally also its haunt,—can know, in short, to what part of nature it belongs, and what function it performs in its general operations,—can state with tolerable exactness over what part of nature it is set, to keep down the redundance by its feeding, and what is set over it, to keep down its redundance. Of the habits of fishes we know much less; but we know enough to enable us to guess at the habit from the form. But the reptiles are quite a puzzle. The four orders of them are so different, not merely in their external powers, but in the fundamental principles of their systems, that they might be made four distinct classes. A frog and a snake are, for instance, in many respects more unlike each other than one of the mammalia and a bird.

Thus, the popular natural history of reptiles is, of necessity, confined to the individual instances of those species which are popularly known; for though a generalisation, grounded upon museum specimens, may be of much use to those who are occupied about them, and may form the foundation according to which knowledge, when it is obtained, may be arranged; yet it cannot be made instructive, or even amusing to ordinary readers. For these reasons, our notices of reptiles, excepting the well-known species, will be more brief than those of the other vertebrated animals. We have stated the reasons in order that the general ignorance of zoologists, in which we of course partake, may not be charged against us individually; we have stated them thus early, because the articles Reptile and Sauria, come late in the alphabetical arrangement; and having done so, we shall briefly enumerate the known characters of the agamas.

Generally speaking, they are rather uncouth, and even somewhat repulsive in their appearance. Their heads are thick and round, or rather ear-shaped, being much enlarged anteriorly; and the throat, and sometimes part of the body, is capable of being inflated to a considerable degree. The body is short, generally thick in proportion to the entire length of the animal; and the tail is, in general, long and round, though in some species it is compressed or flattened laterally. They are wholly covered with small scales, of a lozenge or else an hexagonal shape. These appear reticulated, but the posterior edges are free, and when the skin is inflated they stand up like small spines. The legs are rather slender for the size of the animals; and the toes are five on each foot, all free and armed with claws a little hooked. The toe next to that which answers to the thumb, (though it does not act as such) is generally the longest; and in some of the species it, and the one next it, are much longer than the rest. These, like the rest of the iguana family, are easily distinguished from the lizards, by the structure of the tongue, and the arrangement of the scales on their bodies. The tongue of the lizards is long, slender, extensible, and divided into two filaments at the tip; while that of the agamas is short, thick, fleshy, not extensible, and merely a little cleft at the extremity. The scales on the lizards are arranged in parallel rows or bands at right angles to the axis of the animal, while, on the agamas, they are reticulated or impriential. The scales on the tail again distinguish them from the nearly allied species, Stellio, in which the scales are verticellate, or arranged in rows round the tail, each scale with a spine more or less projecting, and each ring forming a sort of star, or *stellar* arrangement of points; while, in the agamas, the scales on the tail are imbricated or reticulated, as well as those on the body. The scales of the agamas are carinated, and often produced into spines of considerable length, especially on the hinder part of the head. The differences of the scales, which form the chief means of distinction between the agamas and the stellios, are of small value, inasmuch as we do not know the use of the difference in the economy of the animals; but the difference between the family and that of the lizards, in the structure of the tongue, is of importance, as indicative of a different mode of feeding; as the absence of teeth in the palate of the agamas, and their presence in the iguanas, is also a good distinctive character.

The purpose which the inflation of the body may serve in the economy of the animals, whether it enables them to capture insects by beating them down with a current of air, as some fishes are said to do by a discharge of water from the mouth, is not known; and, indeed, the greater part of the history of the race is as obscure as the name, which hangs somewhat in doubt between Αγαμαι, "to be wondered at," and Αγαμος, "unmarried;" but which, in all probability, has no connexion either with the one or the other.

But, whatever function those reptiles perform must be an important one in the general economy of nature, as they are numerous in species, abundant as individuals, and very generally distributed over the warmer parts of the world—in America, in Africa, in Asia, and in New Holland. Many of them are found on the ground only, where they frequent dry and stony places; but there are others which climb with great readiness, and seek their food among the branches of trees. The former have the toes comparatively short: the latter have them much produced. Their food is supposed to consist of insects and other small animals, and also vegetable substances in some of the species.

A list of the sub-genera and species into which the genus has been divided (very differently by different authors) would, for the reasons above stated, be inconsistent with the plan of this work. All of them have the power of inflating the body to some extent, and the inflation is often accompanied by changes of colour, similar to those that have long been known in the cameleon. The greater part of the skin appears to consist of gelatine, which has the power of decomposing light, a power which increases with the thinness of the pellicles, and the convexity of their surface; and thus, as any portion alters its form, all the prismatic colours may in succession be given out by it. This property is of course the most perfect in those that have the finest scales, of which there is a remarkable instance in the variable Agama of Egypt (*Trapelus Ægypticus* of Cuvier). It is a small species, destitute of scales when young; and having them small, scattered, and spineless in the adult state.

One of the most remarkable, as well as most beautiful, species is the blue "helmeted iguana" of the south-east of Asia, known as the cameleon in that part of the world. The body and tail, which is very long, are covered with small reticulated scales; and there are two rows of spurious scales behind the openings of the ears, which form an erectable crest. The colour is a beautiful blue, with transverse white bands on the sides; and the changes are to green and purple; but they are very limited, and reflections rather than any thing else. The eggs of this species are spindle shaped, or much produced and pointed at both ends.

This must suffice as a specimen of this very plentiful genus of living creatures of the tropical climates, a genus of which the history, if once satisfactorily made out, would perhaps throw considerable light upon other points in natural history. None of them are sea animals, and they do not inhabit those parts of the different continents which nearly approach each other, neither could they easily pass from the one to the other upon the sea; and yet in the eastern and western continent and also in New Holland, they resemble each other much more than the mammalia, or even the birds.

AGAMI (Psophia, *Linnæus.*) A very interesting genus of birds belonging to the *gruidæ*, or natural

Golden-breasted Agami.

family of cranes, at least sometimes so classed, and certainly partaking of many of the characters of that family, but combining with them also some of the characters of the *gallinidæ*, and also of the running birds. It is a peculiar genus, and cannot easly be brought into any part of a regular system of Ornithology. It bears some resemblance to the cranes, the pheasants, and the bustards; and yet it belongs to neither. They have one habit of the crane family, that of sleeping upon one leg, with the other drawn up so as not to be visible, and the head bent back between the shoulders. They have also enlargements at the bronchial end of the træchea, by which the peculiar sound afterwards to be noticed appears to be produced.

The generic characters are: the bill short, conical, curved, bent at the tip, and the upper mandible larger than the under; the nasal grooves dilated; the nostrils near the middle of the bill, wide, oblique, curved in front, and closed behind by a naked membrane. The legs long and slender; the tibiæ naked for some distance above the articulations of the tarsi; the toes of moderate length; the outer one in front free, the middle and inner united at their bases; the hind toe articulated on the same plane with the others; the claws not much produced, but sharper and more crooked than those of the gallinidæ. The wings are short and concave, and the bird not adapted for long flights. There is but one known species, *A. crepitans*, the trumpeter, or golden-breasted agami, a native of the forests of tropical America. They are very handsome and very interesting birds; abundant in those peculiar localities which they inhabit, easily tamed and very much attached to man when domesticated, they are very prolific, and their flesh is excellent.

The general plumage is black; the back gray, the breast glossy green with bronze and gold reflections, and a portion of skin round the eyes naked, and of a bright vermillion red, especially during the breeding season. The feathers on the head are downy, those on the lower part of the neck imbricated like scales; on the shoulders pendulous, silky and rust-coloured; the scapular feathers, properly so called, being very long, and hanging over the closed wing. The tail is very short, and consists of twelve feathers. The length of the bird is from twenty-two inches to two feet; but as the great length of the neck compensates for the shortness of the tail, the body is not longer than that of the common fowl, though its form is rather that of the pheasant. The legs are of a greenish lead colour, similar to many of those of the wading or water birds; and when the rains come there is no doubt that the birds are compelled to wade, as they are feeders on the ground; but at other seasons they do not frequent watery places, but rather the openings in the dry woods. They are social, and always proceed in considerable flocks. These flocks are so much attached to each other that they will not separate at the report of a musket, so that when the hunters come upon a flock they are enabled to kill numbers in a short time. They seldom "flush," or take the wing; but when pursued seek to make their escape by running, which they do with great velocity. They are, however, bold birds, and stand resolutely upon the defensive, and are also bold in their attacks, especially during the nesting time.

The broods are three, or at least two, in the course of the year; the eggs varying from two to sixteen, of a light greenish cast, and rather larger than those of the common hen, and much rounder; there is no formal nest, the female merely scrapes a little hollow in the dry ground. The young are capable of running very soon after they come out of the shell; but it is a long time ere they acquire their plumage, as is the case with the bustards. The common cry of the male is not unlike that of the turkey-cock when he wails; but they have another and a peculiar one, on account of which they have obtained the popular epithet of trumpeter, and the specific appellation of *crepitans*. This sound resembles that made by blasts of air in a trumpet, so brief, that, instead of bringing the metal to its tone, they resemble a succession of explosions.

The agami appears to court society rather than shun it, and in some parts of South America domesticated ones answer some of the purposes of dogs. They lead the poultry, and even guide the sheep to or from the pasture; and in the house they are said to be as fond of caresses and as jealous of rivals as the canine race. On foot they are as fleet as an ordinary hound, and though they do not fly far or much, they can, on account of the concavity of their wings, ascend easily into the air, out of the reach of terrestrial foes. They are highly ornamental in their native woods, and also in all places where they have been domesticated; and though they are natives of tropical climates, it is not at all improbable that they might be introduced into England. The flesh of the old birds is nearly equal in flavour to that of the gallinæ, but it is rather dry and tough. The young are, however, very juicy, and the rate at which they multiply would render them valuable in an economical point of view.

AGARIC, or Rock Milk, is an earthy body of a white colour. Specimens are found in various parts of Great Britain; but in much larger quantities in the fissures of limestone mountains in Switzerland, Austria, Salzburg, &c. In Switzerland, where it is particularly abundant, it is used for whitening the walls of houses. The agaric mineral is formed by water passing over and through limestone rocks, and afterwards depositing on their surface the calcareous earth it had dissolved in its course.

Its name is derived from the circumstance of its sometimes assuming the appearance of a vegetable fungus.

AGARICIA (Lamarck). A fixed polypidom, distinguished by subfoliaceous expansions, the upper surface only having stelliferous grooves; the stars are lamellous, sessile, and in rows generally imperfect and difficult to distinguish. The animals are unknown, with the exception of a single species observed by Lesueur in the Antilles; it presents a lengthened opening plaited inwardly, and without apparent tentacules, fringed with a yellow circle, surrounded by eight points of the same colour; the under part is of a fine purple, becoming reddish towards the side.

Seven species are described by Lamarck. They form one of those elegant natural structures well known by the name of madrepore.

AGARICUS (The Mushroom Family). A genus of plants belonging to the *Cryptogamia* of Linnæus, and to the natural order of *Fungi*. This is by far the most numerous genus of plants known; Fries having actually examined and described between eight and nine hundred distinct species, without trusting in any one instance to the authority of other botanists.

AGARICUS MUSCARIUS; *a*, the hollow stipes or stem; *b*, the pileus or cap; *c*, the lamella or gills; *d*, the volva or wrapper; *e*, the velum or veil.

They are in general plants remarkable for their quick growth and rapid decay, some of the species going through all their stages in the short space of four-and-twenty hours; others, however, are formed of tougher materials, and are upwards of a month before they attain their perfect growth; while the greater number last ten or twelve days. In their decay they emit a disagreeable fœtid odour, resembling that arising from putrid animal matter, which substance they are found from analysis strongly to resemble, in this state they afford nourishment to the larvæ of numerous species of insects.

The agarics are found to grow in almost any soil, that of dry and stony places excepted; they are found more particularly in moist and shady woods, where the decayed vegetable matter serves to nourish them; in meadows, on dunghills, on the trunks of trees, especially upon decayed wood; and some species are found to grow luxuriantly in dark mines and caves, where the light of day never penetrates.

The plants of this genus embrace qualities of very opposite characters. Some of them afford wholesome nourishment, such as the *A. campestris*, which form an article of luxury for the table: some of the other species form an important article of food to the Russian peasant; others, however, and indeed by far the greater number, are either poisonous or nauseous in the extreme. Among the natives of Kamschatka, the *A. muscarius* is used as an intoxicating liquor, which produces strong convulsions in all the limbs of the person drinking it, followed by that kind of raving which attends a burning fever. The species that are found useful to man as food will be more particularly treated of under MUSHROOM.

Among the species described by Fries we find very few which are not indigenous to Europe; those which are not so being either of Siberia and the northern parts of Asia, or of North America: in all the colder regions they are found in great abundance, becoming more rare as we approach the equator.

Linnæus and other botanists, particularly Persoon and Fries, have arranged this genus in numerous sub-genera; Fries has made thirty-six of these, in which he considers the leaves of the first importance; the presence of the membrane which covers the leaflets, and the colour of the seed on the contrary, he considers of only secondary importance.

AGATE. An ornamental stone, classed by mineralogists amongst the earthy minerals. The northern part of our island furnishes very beautiful examples of the agate—hence their name of Scotch pebbles.

Moss Agate.

The agate is said to have derived its name from the Achates, a river in Sicily. Its chemical character is principally marked by the large quantity of silica which it contains. The same stone sometimes contains parts of different degrees of translucency, and of various shades of colour; and the endless combinations of these produce the beautiful and singular figures for which, together with the high polish they are capable of receiving, agates are prized as ornamental stones. Although occasionally found in other rocks, they are most usually met with in that variety of the trap rocks called Amygdaloid or Mandelstein, forming detached rounded nodules, not cemented to the base or mass of the rock, but easily separable from it, and having generally a thin layer of green earth interposed, and a rough irregular exterior. In other cases the agate runs in veins for a considerable distance.

There are many varieties of the agate; but one of the most beautiful is the moss agate, in which jasper of various colours, as brown, yellow, and red, appears, as it were, floating in a basis of chalcedony. It exactly resembles moss, and when its arborisations are distinct, it has a very beautiful appearance. The engraving above is copied from a specimen in the collection of the British Museum.

This stone is sometimes cut into snuff-boxes and ring-stones: the larger masses are hollowed into mortars, and sometimes cut into elegant vases. It was much prized by the ancients, who have left us several fine works of art formed of this stone. In the royal cabinet at Dresden, there are some beautiful vases of agate. At Oberstein on the Rhine, the amygdaloid rocks are regularly quarried for the agates they contain, and these are cut and polished, and exported to other countries. The manufacture of the agates of this country, is carried on to a very considerable extent. See JASPER.

AGATHOSMA (Willdenow). A genus of above twenty species, natives of the Cape of Good Hope. They are all evergreen shrubs, suitable for the greenhouse. Linnæan class and order, *Pentandria Monogynia.* Natural order, *Rutaceæ.* The inhabitants of Southern Africa use the leaves of *A. pulchella* dried and powdered, under the name of Buckee, to mix with the grease with which they smear their bodies; to give, in their opinion, an agreeable perfume, though to strangers it is a most offensive scent.

AGAVE (Linnæus). Commonly called the American aloe. A genus of remarkable succulent

Agave Americana.

plants, containing eleven species. Linnæan class and order, *Hexandria Monogynia.* Natural order, *Bromeliaceæ.* Generic character: calyx, coloured, petaloid, tubular and funnel-shaped, in six equal divisions, united at the base to the ovary, which is inferior. Stamens six, inserted in the calyx. Fruit, a longish three-sided capsule, of three places filled with two ranks of seeds. The most remarkable, and perhaps the most generally useful species of this family is A. Americana. The plant propagates itself by seeds, and by a few suckers or offsets. The principal division of the plant extends itself slowly; requiring a period of from seven to ten years before producing a terminal flowers. When these do come forth, they present a most interesting spectacle; the stem rises thirty feet high, bearing hundreds of greenish-white flowers on an elegant branched spike. When the seeds are ripe, the whole division of the plant producing them dies.

This plant has been in our gardens ever since 1640, and occasionally flowers with us; but the low temperature of even our green-houses renders their growth so slow, that forty, fifty, or even (as has been erroneously supposed) 100 years are required to develope the leaves and flower stem. It is quite certain, however, that provided the plant were allowed the requisite heat, it would arrive at its natural amplitude, and flower at its natural period of ten or twelve years. It is also more than probable that any *full grown* specimen of the plant may be flowered in any year the owner may wish, by merely placing it in a hot-bed of bark-leaves or dung.

Its usual flowering season is August, and it continues in flower for two or three months, after which it perishes.

The different parts of this plant are put to a variety of uses. In many countries in the south of Europe the leaves are used for making fences, which on account of the spines along the margins of the leaves are of a very impenetrable nature. The fibres of the leaves, after being deprived of their pulp and juice, are made into thread and cordage of different kinds, not, however, of a very strong or durable nature. The leaves when cut into pieces, are also said to be given as food to cattle. The juice of the plant, in the form of extract and made into balls, has been used in place of soap. The sharp spines are used for pins and nails.

Another species, the *Agave Mexicana*, or wild agave of Mexico, called *Magnay* by the natives, yields in great abundance a juice whence wine called *pulque* is made. From this wine a colourless spirit, like whiskey, is obtained by distillation. This spirit receives the name of *vino mercal.*

AGENEIOSIS. A genus of abdominal malacopterygeous fishes, belonging to the natural family of *Siluridæ*, or those with the skin naked, or without scales; but they have not the fleshy appendages which are attached to the under jaw of some of the family. Instead of which, one species has a short horny spine, notched or jagged in the margins; and the other species (there are but two known) has a small horny buckler in place of the spine. The siluridæ are all fresh water fishes; and the two species of which this genus consists are found in the rivers and lakes of the tropical part of South America. They feed partially upon the seeds of vegetables; and their flesh is not much esteemed as food.

AGERATUM (Linnæus). A family of exotic annuals containing six species, cultivated in botanical collections. Linnæan class and order *Syngenesia Æqualis.* Natural order, *Compositæ.* Generic character: Head of flowers flosculose; involucrum hemispheric, composed of several little leaves; flowers hermaphrodite, tubular, having four or five teeth; anthers united, exceeded in length by the style; seeds quadrangular, crowned with little awl-shaped scales.

AGLAOPHENIA (Lamouroux). The species of this class have hitherto been confounded by authors with the *Sertulariæ*, notwithstanding the many and constant characters which constitute them a very different group. They are plant-like and horny, furnished through the entire length, and on the same side, with auxiliary or insulated cells: their small polypean lodges are sometimes placed between two appendages, like a flower in its calyx; the upper appendage is at other times wanting, and the lower may then be compared to the bractea of an axillary and sessile flower. Some have their cells isolated and placed at regular distances from each other; others form groups at each articulation, but the distinguishing generic character of having the cells on the same side of the branches is invariably observable throughout the species.

The aglaophenias are of a horny substance, membranous, and flexible. Their colour fawn, varying greatly in intensity, does not present those vivid tints that adorn some of the *Sertularias* or *Corallines*, but they excel those polypidoms in the elegance of their form and in the position of their branches, which are gracefully arched over each other, resembling the waving plumes of the ostrich. Their height varies from four to twelve inches, and sometimes more. They are found at various depths in the seas of all latitudes, frequently parasites on the Thalassiophytes and submarine productions; sometimes adhering to rocks by fibres more or less numerous. Twenty-two species are known.

AGLAURA (Savigny). A genus of *Annelides*, adopted by Lamarck in the third division of his Articulata. It is a molluscous animal possessing nine jaws, five on the one side and four on the other, the lower with strong tooth-like processes; it has three short antennæ or fibres; the head is concealed under the first segment of the animal's body, the forehead bilobate; the eyes indistinct, and the animal destitute of tentacular cirrhi. This name is also applied to a little species of zoophyte, which is found at Nice.

AGOUTI. A genus of mammalia, belonging to the order *Rodentia*, or gnawers, and the natural family of *Caviadæ*, which the more modern naturalists have very properly divided into four genera, instead of the single genus of their predecessors. The characters of the order, and those of the group or family, will be found under their respective titles; so that in this article it will be necessary to mention only the genus and the species.

Common Agouti.

In their general appearance and habits, but more in their habits than in their appearance, they bear a considerable resemblance to hares; and they have accordingly been called hares and rabbits by English visitants or residents in the places where they are found. Still, they are so essentially different, that neither of the names is at all applicable. They do not burrow in the earth like rabbits, neither do they squat upon forms, in exposed places, where they can watch, as is the habit of hares. Their lodging-places are intermediate: under fallen trees, in the holes of decayed ones, or under stones and rocks.

Though, like the hares, and many other animals of the order, they can gnaw bark when other provisions fail them, and though their *incisor* teeth are well adapted for cutting, and their *molar* teeth for bruising and grinding vegetable substances which have a considerable degree both of hardness and of toughness, yet both their food and their manner of feeding are different from those of our hares and rabbits, which are the only European animals resembling them in general character and in size.

They are all inhabitants of the American continent, or its tropical islands; and they may be said to inhabit only those places which have a tropical character; for, though some of the species are found as far southward as the Straits of Magellan, yet the country there is much more tropical in its climate, its seasons, its vegetables, and some other of its animals, than the corresponding latitudes of Europe or of North America; and the agoutis are just as well adapted to the more fertile of the comparatively dry places of Central and Southern America, as hares are to the fields of Europe, or squirrels to the Canadian forests.

When first taken possession of by Europeans, the West India Islands, and all the more fertile parts of South America, were literally overrun with these animals; they are still very numerous in all places which are not settled and cultivated; and in some which are cultivated, their numbers are so great as to give no little annoyance to the planters. They are thus very characteristic of the country, much more so than some other animals which are individually more striking; and therefore they are well worthy the attention of every one who wishes to have a knowledge of that extensive and highly interesting portion of the globe.

Their generic characters, or those which distinguish them from those other genera which they most nearly resemble, are: two cutting teeth and eight grinders in each jaw, the latter far apart from the former, all nearly of the same height, and much furrowed on their grinding surfaces by irregular alternations of bone and enamel; the feet with four toes on the fore and only three on the hind, all armed with rather long, flat, and blunt claws; the legs rather short, and the fore ones shorter than the hind; the head roundish, but tapering to the muzzle; the ears of moderate height, erect, broad, and nearly naked; the eyes smaller and less prominent than in the hares; the tail short and naked, or a mere tubercle; the outline of the back arched, and that of the belly nearly straight. The slow motion, rather an awkward walk; the quick one, jerking or leaping. The hair on most of the species is coarse and bristly.

The whole structure and aspect indicate an animal which can make its way either through tall vegetation or along the dry and naked ground, which are the conditions of the places which these animals inhabit in the two seasons of the tropical year, the rainy and the dry. During the first of these there is plenty of green food on the tropical plains, and in the openings of the woods; but during the second, green vegetation disappears from the surface, unless in places which are rather humid for the agoutis. At that time, however, there are an abundance of bulbous and other succulent roots, either exposed on the surface, or situated at no great depth below it; and though the animals do not form burrows for their habitations, their spade-like claws, no doubt, assist them in getting at these. They are, however, timid animals; and, though numerous, their habits are not very well known. It is not ascertained how often they breed in the course of the year, or how many young they have in a litter; but they must breed rapidly, as they have many enemies, and still are numerous. The cats and other beasts of prey take many of them; and they are eagerly sought after, both by the Indians and the European inhabitants, their flesh ranking nearly as high in that country as that of hares and rabbits with us. They do not afford sport as "chace" game; but rather endeavour to hide themselves from their pursuers; and when they are traced to their hiding-places, they utter a feeble and wailing cry, and suffer themselves to be taken without making any resistance.

They are, strictly speaking, "surface animals," which neither dig to any depth, nor climb; and, though they can hold their food between their fore feet, using the two something after the fashion of one hand, their principal strength is in their hind legs, though it does not appear that they use these, or indeed any part o. their bodies, for attacking other animals, or even for the purpose of self-defence. They sit upon their hams, with the fore legs free, as well when they are eating as when at rest; and when the vegetation is tall, they clasp the stems between their fore-legs, and so reach those parts which serve them for food; but it is in the gnawing of roots, especially those of the sugar-cane, that they are most annoying to the planters. Though they resort to the plantations in great numbers, they are not gregarious; but inhabit indiscriminately wherever the situation and food are adapted to their habits. There are, at least, four species.

The Agouti (*A. acuti*) is the size of a hare, that is, almost twenty inches long and a foot high. The ears are round and naked, the eyes rather large, the contour of the head arched; the upper jaw projecting, with the lip cleft, and the nose considerably dilated. The tail is very short and naked. The hair all over its body is coarse and bristly, and about an inch in length, while on the rump, or hinder part of the back, it measures four inches. The elongated hair is bright orange yellow, and inclined backwards; the rest of the upper part is mottled with paler yellow, brown, and greenish black. The under part is pale yellow; and the feet and whiskers black. The range of this species is considerable, being from the isthmus of Darien to La Plata, and it is also found in several of the Indian islands.

The Black Agouti is smaller in size, and has the hair on the upper part nearly black, and the produced hair on the rump entirely so. In form and habits it differs little from the common species, and may be only a variety. It also inhabits nearly the same places, only it is more rare, and probably not so widely spread. It appears to inhabit more dry and elevated places than the other. That may have some influence upon its colour; for our cattle from the northern and elevated moors are smaller in size than those of the low and rich places; and black, while these are generally dun, brown, or similar colours, marked with white.

The Acouchy (*A. acuchi*) is still smaller, lower on the legs, rather more slender in the body, more straight in the outline of the forehead, and more slender and inclining to being pointed in the muzzle. The whole body has something more of a weasel-shape; and there is a sort of tail, though a very slender and nearly naked one. The hair is finer in its texture that that of either of the species formerly mentioned; and in colour it is a sort of intermediate tint between the two. The produced hair on the rump, which is proportionably shorter than in the former species, is black;

and the rest of the upper part, though distinctly annulated with colours nearly similar to those of the common species, is much darker.

The Patagonian Agouti, or *Mara* (*A. Patagonica*), which inhabits regions farther to the south, and therefore less tropical in their character than those which are inhabited by the other species, has corresponding differences of appearance. It is larger in size, shorter and stouter in the body, has the legs longer and clearer in their make, the neck and head more slender, and altogether it has more the air and expression of an animal which ranges over open pastures than of one that threads the brakes, which is indicated by the weasel-like shape of some of the species. When full grown, the mara measures two feet and a half in length, and more than one and a half to the most elevated part of the arched back. The outline of the back does not sink so low at the shoulders as in any of the former species, and the union of the neck with the body is more marked. The ears, too, are longer, more pointed and erect, and the contour of the forehead is nearly a straight line. The texture and colours of the covering are also different. It is soft, and the prevailing colours are fawn on the upper part, and white on the under. Anteriorly the fawn colour is mottled with white, and inclining to black on the mesial or ridge line, which increases in depth to entire black on the croup, forming a definite outline on the hams for half their external breadth, on a level with the rudimental tail, below which the hinder parts of the hams are white, as is also the chin, and the middle of the throat and belly. These markings, and also the form of the hinder part, and the shortness of the body, give to that part of the animal some resemblance to a deer; but the resemblance is slight, and confined to the parts behind the shoulders, and above the dorsal joints. The feet are distinctly those of the rest of the genus, only the toes are more slender, and the tarsi of the hind ones more produced, and have the peculiar flexure of those animals which squat on them and the hams, so as to be able to have the fore legs free while the body is in an erect posture.

The habits of the mara resemble those of the hares more than the other agoutis. They live on the open plains, feed chiefly upon green vegetable matter, of which there is a successsion of crops, such as clover at one time and thistles at another, during the greater part of the year, in America, from the Pampas southward. They do not burrow, but squat on forms, generally in the cover of herbage; and though they are not gregarious, the pairs generally continue together all the year, the female hiding her newly-dropped young for some time in the deserted burrow of some of the digging animals, with which the same districts abound. They are timid animals, and seek safety in flight, so that they afford chase; the mode of capturing them being by following on horseback, and throwing the *bolas* (two iron balls united by a cord), which the people of that country use with great dexterity. In a natural system, or one in which animals were classed according to their general structure, habits, and haunts, it is probable that the mara should be a genus separate from the true agoutis.

AGRIMONY (Linnæus). A genus of herbs found on the northern parts of both continents. Linnæan class and order, *Dodecandria Digynia*. Natural order, *Rosaceæ*. The *A. eupatoria* is a British plant, common on hedge-banks; formerly of some repute as a medical herb, and still used in herb teas.

Agrimonia Eupatoria; *a*, flower, showing the twelve stamens *b*, the five pistils.

The root in spring is sweet-scented, and the flowers fresh gathered smell like apricots. When the plant is coming into flower it dyes wool a dull yellow, and if gathered in September a still deeper shade. Formerly it was used for dressing leather.

AGRIONIDÆ (Dragon Flies). A family of insects belonging to the order *Neuroptera*, the *Libellula* of Linnæus, and which Dr. Leach has named, and separated into two genera, from the *Agrion* of Fabricius.

All this family have a long, slender, and cylindrical body, many of them variegated with beautiful colouring; in some of the exotic species, the length of the body is five inches and a half, and not thicker than a good-sized quill. They are all very powerful on the wing, and possess the faculty of flying backwards and forwards without turning. In some of the genera belonging to this family, the insect rests with the wings expanded, so that it can take itself to instant flight without further preparation; in the genus Agrion, however, this is not the case, the animal always resting with the wings erect.

The A. puella appears to be subject to some variety, but it is possible others have been confounded with it; the body, in general, is of a most beautiful blue in the male, and bluish grey in the female. They inhabit the rushes by the sides of ditches, and are one of the commonest of the British species, of which Stephens, in his catalogue, enumerates ten. We should recommend to the entomologist, as the insects of this genus are very delicate in their bodies, and will not admit the usual process of filling with cotton, after the removal of the contents of the abdomen, as in the larger libellula, that a needle furnished with a coloured working cotton be passed through the body, which would possibly save the colours, and certainly strengthen the specimen.

Genus Lestes, (Leach,) wings membranous, with an oblong-quadrate parallelopiped stigma: abdomen of the male armed with a forceps-like appendage. The

Les. autumnales (Leach) inhabit marshes, where they may be found in August and September.

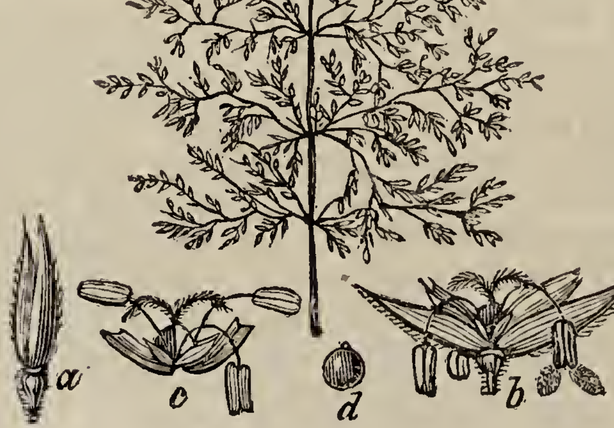
In the genus Calepteryx, the wings are membranous, without a real stigma, in place of which we sometimes find transparent spots; the abdomen of the male is furnished with a forceps-like appendage.

The Dragon-fly.

The species vary much in the colour of the wings, which are sometimes bluish, brownish, black, pellucid with a broad black fascia, pellucid with white tips, or with brown tips and a white dot.

Inhabits in the larva-state streams and rivers, and in June and July may be found on the banks; it is abundant on the Lea, in the Hackney marshes. This is one of the species that require no preparation in the preservation of their colours; it is undoubtedly one of the most brilliant British *Agrionidæ*.

AGROSTIS. A name derived from the Greek word αγρος, *a field*, and applied to a genus of grasses, containing a considerable number of species, five of which are natives of Great Britain. Generic characters. panicle or cluster of flowers loose; calyx consisting of two unequal scales or glumes longer than the corolla; corolla of two unequal valves, the outer one frequently being furnished with an awn.



Agrostis Capillaris. *a*, the bivalvular one-flowered glume; *b*, the same opened, showing the flower; *c*, the flower taken out, to show the two valves of the calyx, and the two scales; *d*, the seed.

The *Agrostis vulgaris*, common bent-grass with its dwarf variety, and the *Agrostis canina*, or brown bent-grass, are abundantly met with in fields and pasture lands, and on account of their earliness are esteemed in agriculture. The *Agrostis setacea*, or bristled-leaved bent-grass, is chiefly found in the south of England; and the *Agrostis spica venti*, or silky bent-grass, grows principally in the neighbourhood of London. Another British species, the *Agrostis alba* or stolonifera marsh bent-grass, is very abundant in Ireland; and under the name of *Fiorin-grass* has been greatly praised by Irish agriculturists for the purposes of fodder. It thrives well in wet marshy soils, and is said to yield an abundant and luxuriant crop.

The Agrostis family are met with in greatest abundance in temperate regions. One species, the *Agrostis algidæ*, is interesting on account of being one of the few plants found in Spitzbergen. In the torrid zone the species of Agrostideæ have been estimated to amount to fifty-eight, or one-fourteenth of the whole grasses of that zone, while in the temperate zone they amount to 220 or one-fifth of the whole. In South America the Agrostideæ occur most abundantly in the elevated mountainous districts.

AI (The three-toed sloth, *Acheus tridactylus.*) A genus of mammalia, belonging to the order of *edentata*, or toothless animals, and the natural family of *tardigrada* or "Sloths," one of the most singular in their forms and habits, and, according to our notions, one of the most uncouth, in the whole range of the animal kingdom; but still as admirably adapted to their haunts and modes of life as those species whose forms we admire the most.

The general characters of the group will be mentioned under its title; but it may not be improper to remark here, that the words "tardigrada" and "sloth," the one expressive of sluggish motion, and the other of indolent disposition, are both misapplied in the case of these animals. In their own proper place, they are neither laggard nor lazy; and their formation, though, according to our common notions, it is singular and ungainly, is not only better adapted to their peculiar haunts than the structure of any other animals with which we are acquainted, but better than any that we could have imagined, if the problem had been proposed to us to find the structure of an animal without wings, which should find its food, and spend the whole of its life, among the tops of lofty trees in close forests, and so maintain its footing there, as that no ordinary tempest—not the hurricane in the utmost of its fury—could shake it to the earth.

The haunts of these animals are the deep, extensive, and luxuriant forests of South America; forests in which the trees are of giant growth, always green, so close that rarely a beam even of the vertical sun reaches the earth; and they extend over districts so wide, and are so festooned and interlaced with various species of *epidendra*, or twining plants, that winds, which would level our single trees with the ground, or rend our most serried woods to tatters, barely agitate their tops, or disfigure a few on the sides of the openings. In all parts of nature there are counteractions; and in order that there may be seeds and successions of races in those luxuriant forests, it is necessary that there should be some consumers of the superabundant foliage, which, otherwise, would completely exclude the sun and air, and the forest would perish of the excess of its own exuberance, leaving the naked and carpetless earth to be converted, by the fervour of the tropical sun, into an arid waste, upon which no living thing could exist. If the forests were, in this manner, to be destroyed, or indeed in any way but one in which their place should be occupied by a close surface vegetation (and in those climates there is none such known, save culture by man), the rain would be gone also, and the land would be put beyond the power of human skill and labour to bring it back to usefulness, either for man himself or for any other living creature. On the deserts with which we are acquainted, in the tropical parts of the world, there are sometimes pestilent dews, from the difference of temperature between the night and the day, the cold of the former being increased by the partial melting of the salt with which the surface of such places is generally strewn; and the heat of the latter augmented both by reflection and radiation from the burning surface; but there fall no kindly showers; and, "once a desert, always a desert," till some of those mightier movements of nature, of which the records are written in the strata of the deepest mines, and the loftiest mountains, shake the ruin to pieces,and mould and temper its elements anew.

Wherever the earth is green, there are browsing animals. But in those tropical forests, the green is not upon the surface, but on the tops of the trees; and the browsing animals must be fitted for making these their pasture. A pasture suspended in the air must have those which feed upon it suspended in the same element; and the question may here be put, "should they be suspended *above* their food or below it?" Green leaves cannot form a *footing* for any animal of sufficient size to feed upon them wholesale as a browser; and it is not easy to see how an animal could browse on the wing; so that, according to all that we know of the laws of animal action and of those of matter, it does not seem consistent, or even possible, that the leaves of a tropical forest could be browsed by an animal above them. But an animal suspended from the twigs or branches upon which the leaves grow, and "holding on" by the action of its weight on the points of suspension, could have command of itself and feed; and this is exactly the habit of the sloths, and their organisation agrees with that habit. Their position is reversed as compared with that of animals which walk the earth; and it is in keeping that their organs of motion should be reversed also.

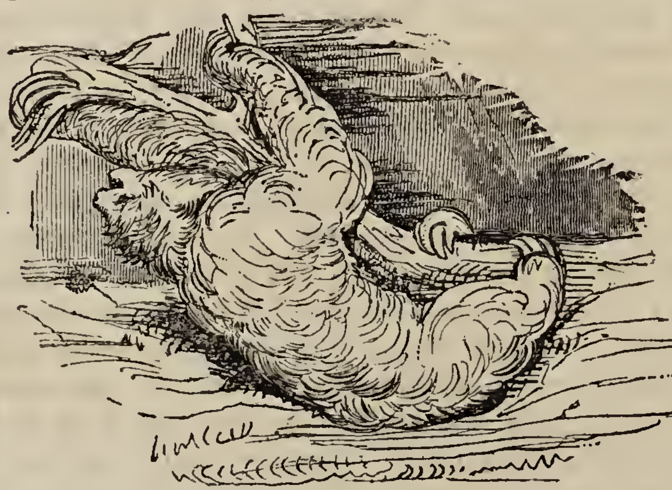
Much as has been said and written about the clumsy and helpless structure of the sloth (for even Baron Cuvier, while forming a system of animals according to their structure, says, they are formed as if Nature had "wished to amuse herself in the production of something imperfect and grotesque"), there are cases in which we take him as our model. When a sailor "warps" along a rope, he is obliged to do it as the sloth does; and the chief difference is, that he does it more clumsily. The arms in man close toward the centre of the body with their most powerful hold; and though the hands can grasp at different angles, the firmest grasp, and that which can be maintained the longest, is when the grasp is in a plane parallel to the mesial plane of the body, as nearly coincident with it as possible, and the fingers turned inwards. The quadrumana grasp in the same manner; but their grasp, as well as our own, is by muscular effort, and as such it is labour, whereas the holding on of the sloth is repose, in the same sense as is the suspension of bats by their hooks. Their suspension is wholly by the claws, so that no part in which there is any circulation is pressed by their weight; and thus, whether in their progressive motion or in their repose, they really appear to suffer less than any other animals. In their repose, they hang by all the four feet, which are as nearly straight as possible, till the last phalanges of the toes are arrived at, and these are "stopped" by processes of the bones, just like a stop hinge, so that they cannot make other than a hook, with its point directed to the mesial plane of the body. When they exert themselves, the claws can be brought close to the upper part of the wrist, and thus they can hold firmly by the most tender twig; and the hind feet, which hold on while the fore ones are bringing the leaves within reach of the mouth, have a projecting heel bone, for greater security. Each foot can act separately, and thus they can feed on the trees as near the extremities of the branches, as four twigs, or as many times four of the smaller ones as they can grasp between the foot and the long claws, will bear their weight. In ascending the stems of trees, their claws act much in the same manner as "climbing irons;" but even then they are always most secure, and move fastest, when the stem leans over them, and they can bring their weight to the aid of their grasp.

Mr. Waterton, in whose "Wanderings" in the forests of Surinam, there is the most correct, and certainly the most lively account of these singular animals, mentions that they avail themselves of those winds which agitate the trees, and bring their branches into contact, in order to make their migrations from part to part of the forest, which they do with considerable velocity; and that they should choose for their most active motions those times when the quadrumana and the climbing birds are forced to descend for shelter, is another proof of how admirably their structure is adapted to their haunts.

That they should be awkward on the ground is not to be wondered at; for as they are seldom there except in cases of accident, to have given them the power of walking well would not only have been giving a superfluous power, but one which could have been obtained only by the injury of that which is most essential to the animals; for it is a principle of the animal structure that the perfection of two systems for the same kind of action, whether that action be locomotion or not, are incompatible with each other in any one species. On the ground, the sloth is out of its element; but it is not so helpless there as a herring upon dry land, or a peacock in the sea. The turning inward of the wrist and ankle joints, so as to make the claws shut on the mesial plane, necessarily brings the side of the foot to the ground, and not the sole, which prevents any of the joints of the foot from coming into play there; and the most ready and powerful action of the knee and elbow joints being in the same direction, renders them of little use; so that the whole of the motion there is at the articulations of the humeral and femoral bones, and not very perfect or powerful even there. We have only to imagine how a man would walk if he had the power of progressive motion only at the hip joints, and that the knees and ankles had a continual tendency to have the parts articulated at them inwards, and then we can form some idea of the sloth's motion along the ground.

The generic characters of the Ai are :. no cutting teeth in either jaw; four molars and one canine in each side of the upper jaw, and three molars and one canine in each side of the lower. The whole teeth nearly of the same form—cylindrical, of soft bone cased with enamel, but with no plates of enamel in their substance. They are not, therefore, adapted either for biting or for grinding, but merely for pulling off the leaves, which are taken into the stomach with little preparation in the mouth. The stomach consists of the same number of divisions as that of the ruminating animals, but the sloths do not ruminate. There are only three toes on each of the feet, the bones of these, answering to the little finger and the thumb, being merely rudimental, and united to the bones of the palm, which also become soldered together long before the natural death of the animal. The fore legs are very long, nearly double the length of the hind ones, and the neck is usually described as consisting of nine vertebræ, while in all the other mammalia, as far as is known, it consists only of seven. This last character is, however, incorrect: there being only seven cervical vertebræ, or those without articulated processes; but the first and second dorsal vertebræ follow (naturally enough when the habit is considered) the structure of birds, and the ribs attached to them are not joined to the sternum. This formation allows of more motion to the head, which is raised upwards, and rests on, or is received, between the fore legs, when the animal hangs from the branches asleep. The young is brought forth on the trees, and hangs suspended to the mother, whose teats are pectoral and two in number, till it is able to suspend itself from the branches, and find its own food. There is, indeed, a curious jumble of resemblance to some parts of the human structure in these very curious animals. Two species are described, similar in habits, though differing in appearance; and there are probably more species, or at least varieties. The places which they inhabit are very difficult to explore; and therefore their numbers and habits are but imperfectly known.

The common Ai, of which the following figure is a representation, appears to be the most abundant



The Ai; or, common Sloth.

species, or, at all events, the one which is best and has been longest known. It is about the size of a large cat, with the head short and round, the face yellowish, with brown rings round the eyes, which give them the appearance of being placed under an eye-brow. The face is covered with very short hair; but that upon the rest of the head, the body, and the feet, down to the very claws, is long, shaggy, and of a very peculiar texture. It is turned back from the face, and divided from a centre near the top of the head, something similar to the crown of the human head, and all over the rest of the body it is matted. The form is very peculiar, being slender at the roots and flattened at the points, as if every pile was a blade of grass, inserted by its narrow point. It wants the gloss of ordinary hair upon the living subject, and feels sapless and dead, as if it consisted of withered vegetable fibres. The colour is grey, but variously marked, and mottled with black, brown, and white, not unlike a portion of a tree covered with lichens; and in its colours, and also the length of the hair, it is liable to considerable variations; but whether of age, sex, season, or difference of exposure, has not been ascertained.

The collared Ai has the head not quite so rounded, the muzzle a little more produced, the face black, a black collar round the neck; the hair on the head yellow, on the rest of the upper part orange, and on the breast and upper part of the belly rust colour. The hair on the head is more produced than on any other part; and over the whole animal is not so flattened, shaggy, and withered, as in the common species.

Both are inoffensive animals, following their curious mode of life in the forests without offering the slightest violence to any living creature. When the air is dry, hot, and still, they are mostly at rest during the day, and their suspension from the under sides of the boughs protects them alike from the action of the sun and from enemies. Whether in that state of the weather they move more during the night has not been ascertained; but it is probable that they do, as the leaves of the trees are then refreshed by the dew. As has been already mentioned, the increasing of the storms puts them in motion, and they then utter their plaintive cry, of which the name "ai" is a pretty close imitation. They are very tenacious of life, more so than most of the mammalia. Their clutch is also formidable, if they are attacked on the ground, where they throw themselves on their backs, and defend themselves with the extremities of the paws with the greatest resolution; and if they seize hold, they do not quit it till the enemy is dead.

The habits of these animals are not only interesting as being characteristic of some of the thickest and most entangled forests now remaining on the globe; but as, in so far, indicating what must have been the state in former times of those portions of it where the skeletons of animals of the same family, but as large as that of the elephant, are found in the ground. See Megatherium and Megalonyx.

AILANTUS (Linnæus). Two very beautiful Chinese trees, one hardy enough to bear the climate of England, usually raised from imported seeds; the other requires the protection of a hot-house. Linnæan class and order, *Polygamia Diœcia.* Natural order, *Terebinthaceæ.* Generic character: male flowers—calyx, one-leafed, five-parted, very small; corolla five petals, acute, convolute at the base; stamina, filaments ten, compressed, the length of the corolla. Female flowers—calyx as in the male; corolla as in the male; styles lateral; capsules compressed; seeds solitary, lens-shaped. Bisexual flowers as on the above.

AILURUS. (Literally "parti-coloured tail," though the same was one of the Greek names for the common domestic cat, and no doubt applied to those varieties which have the tail marked with a series of rings of different colours.) A genus of mammalia, belonging to the order *carnivora,* or preyers upon flesh, properly so called, and of the family of *planti-*

grada, or walkers on the flat of the feet. The last character must, however, especially in the hind feet, be received with some explanation, as there are none of the carnivora which walk on the entire length of the tarsi of these when they walk upon all fours.

Only a single species of this genus is known, *Ailurus fulgens*—the *panda*, *cheetquha*, and various other names of the mountaineers of northern India. The last name is compounded of "cheeta," the Indian name of the smaller leopards, or larger cats, and "quha," the cry of the animal as nearly as it can be expressed by letters.

The panda is but a recent addition to European zoology. The animals to which it bears most resemblance are the *raccoons* of the American continent, but the following figure will give a better idea of its shape than could be derived from a verbal description.

Ailurus fulgens.

The whole length of the animal is about forty-two inches, of which the head occupies seven and a half, the neck four and a half, the body fifteen, and the tail the same. The face and parts of the ears are white, with a few fulvous hairs, and a fulvous patch on each cheek. The neck and back of the ears are deep yellow, which passes into golden yellow on the ridge of the back, and from that to yellowish brown, with sprinkled hairs of golden yellow on the rest of the body. The tail is ringed with yellow and fulvous brown, which pass gradually into each other, and its tip is black. The fur on the body and tail is very thick and close, and rather long. The legs are short and stout, and entirely covered with blackish woolly fur, including the soles of the feet; and as the bright fur of the body hangs so far over them, they have the appearance of being inserted in the body like the feet of a stool. The toes are five on each foot; the claws rather long and partially retractile; but they are straight, and so not adapted for clutching. The teeth are singular. The cutting teeth are conical; the canine nearly straight; there is one false grinder in each side of the upper jaw, and two in each side of the under. The first false grinder is a flat cone shouldered at the base; the shoulder of the second rises into tubercles, about half the height of the central cone; that of the third rises nearly to the whole height; and in the remaining ones all the tubercles are nearly the same, and in the aged specimens they are flattened or truncated at the points. This last circumstance was at first proposed to be made a character of the animal, and led to the supposition that it fed partly on vegetables; but it has been found to be merely the result of wearing.

The panda is a mountaineer, inhabiting the banks of streams and torrents on the secondary ridge of the Himalaya mountains, between Nepal and the snowy summits. It lives much in trees, and catches birds with dexterity. Its furry feet enable it to steal onward with silent tread, and to traverse the snow without inconvenience. Very little is known of its manners, but its aspect is not ferocious; and as it is an animal of singular beauty, and a native of a cold region, there is some probability that, by a little care, it might be added to the list of our domestic mammalia.

AIR. (From a Greek word which signifies "to breathe.") The gaseous fluid of which the atmosphere is composed, which everywhere surrounds the earth to a much greater height than any living creature, animal, or vegetable can be supposed ever to ascend, and which penetrates the earth and the water, at least to the greatest depth at which any creature of what kind soever can live and grow. Air is so important an agent in the economy of nature, that no portion of Natural History can be understood without a knowledge of its nature and properties. In so far as these are mechanical or chemical, and have relation to mechanical or chemical arts, they belong to the first division of the Cyclopædia. But the Natural History properties of the air are highly important, and correspond more nearly with its physical properties as matter, than those of almost any other natural substance.

In order that our understanding of this agent may be clear, and expressed in short space, it becomes necessary to subdivide our notice of it, and consider it as *air*, and also as *atmosphere*. Under the first of these titles, we shall have to consider it as local and temporary, without reference to extension in space, or succession in duration; and under the second (for which see ATMOSPHERE,) we shall have to consider it with reference to varieties of climate and successions of seasons, and all the effects which result from these.

The air, taken in its simple and more restricted sense, needs no definition; and indeed, considered merely in itself, it does not admit of any. It is not apparent to or cognisable by any of the human senses; and therefore it can be described only by negatives, which do not amount to definition. Like animal life, or the human mind, of which in almost all languages it is the type and the name, it is known only by the functions which it performs, or the phenomena which result from the actions that take place between it and other things. These, however, are often as grand, and even terrific, as they are important in their results.

Air is a compound fluid, consisting substantially of oxygen and nitrogen gases, in nearly the same proportions under all circumstances, and it also receives into its mass many other gases, and also liquids and other substances not gaseous, in that state of minute division which is called *vapour*, and by a process, understood to be always the same in kind though differing in degree, which is called *evaporation*. That process is a very important one in the economy of nature, as all land plants and animals may be said to depend upon it for their subsistence; but it belongs to the general consideration of the atmosphere, and not to air as temporary and local.

But though air consists of two principal ingredients, and also admits of other substances being diffused through its mass, it is merely a *mixture*, and not a *compound* in the chemical sense of the word. This state of it is highly important to be known, not only in order to prevent us from drawing false conclusions from those phenomena which take place by the action of the air or of some of its ingredients; but also as affording one of the most beautiful of those instances of design and adaptation of which creation is so full.

It is a law of all action, whether natural or artifical, that no change can take place without the exertion of what we call *power;* and the power by which the change is effected must always be greater than that which maintained the substance or substances in the state out of which they were changed, or, in other words, greater than that by which they were brought into that state. As for example, it always takes a greater exertion of power to separate two substances chemically combined than it did to combine them and hold them in combination; and so also it takes a greater degree of power to combine them anew than that by which they were separated and held asunder.

This is the general law of all natural action, indeed of all action whatsoever; and it is necessary that every one wishing to have scientific knowledge of nature, or indeed of any thing else, should have the clearest possible notions respecting it. A state of perfect equality in power would be a state of total inaction—of universal death and quiescence; and a creation of which that were the law could produce nothing and would be good for nothing. That the stronger only can vanquish, and the weaker only can be vanquished, is, when the facts are known, the law equally of the whole and of all the parts down to the most minute; and it is a law to which there are not even the most temporary exceptions. Ignorance of this law is the cause of all the failures which take place in human attempts; and *impossibility* is only another name for its attempted violation. This alone would justify the length at which the principle of the law has been stated, and strongly recommend it to the most attentive consideration. But if it were our province to treat of the practical application of mechanical and chemical science, we could fill volumes with instances in which human ingenuity has been most lamentably wasted, solely from ignorance of or inattention to this universal and most important law.

It must be borne in mind, however, that time is an element as well as intensity; and though we are not warranted in saying that the effective power is always the product of the time and the energy, yet our inability of doing so depends on the nature of the energies and on the contingencies on time, rather than upon any improbability in the doctrine itself. Before returning to our proper subject, the air, it may not be amiss to mention an instance or two, in order to fix this, the most important truth, perhaps, in the whole three kingdoms of nature, upon the minds of those readers who are not accustomed to such considerations. Then, in the first place, the timber of an oak tree, treated with proper skill, suffices, in the course of not very many hours, to convert, by the help of the workman and his tools, a lump of iron-stone into a steel hatchet. The tree may have taken a hundred years in growing, and the iron-stone a longer time in consolidating; but the rapid decomposition of the tree—the undoing of that which it did during its growth, affords a power concentrated in intensity from being shortened in time, before which the stubbornness of the iron-stone must give way. It may be that the oak is first burnt into charcoal in a smouldering fire, and the iron-stone roasted in a slow oven to clear it of sulphur; but the object of these operations is to get rid of volatile substances which would scatter the heat and also the substances acted upon. Again, a very small quantity of gunpowder, duly applied and ignited, will rend in pieces many tons of the toughest rock; and we cease to wonder at the result when we reflect upon the length of time during which the charcoal was growing, the saltpetre forming, the sulphur subliming by volcanic heat, and the labour of making the powder, all of which were undone in that momentary explosion.

Now, when we turn from these instances of strong natural action, and consider the air, formed of ingredients which can be mixed or separated instantaneously and without effort, save that which is necessary to overcome the inertia of the particles; and that these particles are so small and light that the number of them in a grain probably exceeds that of the grains in the mass of the earth, and that they are all but self-mobile, we see what a wonderful element the Creator has prepared for his creatures. From the giant of the forest to the mucor on the humid stone—from the whale in the ocean and the elephant in the jungle to the viewless animalcule, which prints doubt upon the finest microscope, there is a wonderful range of organs, in magnitude and in energy, but the air is equally obedient to them all; and the little things, of which a thousand may be lifted on a pin's point, or hung in a drop upon the most slender cobweb, find themselves as competent to receive life from that, as those which shake the earth with their tread, or cause the ocean to boil with their plunge.

And the same minuteness of division enables the air to find its way to every place where its presence can be required. There bores not a worm, there descends not a root, so deeply into the ground as that the air cannot reach it, so that to all that grow and live above the surface, on the surface, or under the surface, the air is the breath of life; all are equally refreshed by it, and the most feeble is no more fatigued by it than the most powerful.

To us, the water, whether of the lakes and streams or of the ocean, seems a compact and continuous liquid; and neither the eye nor the microscope can find in it any pores or interstices; and yet we have no reason to doubt that air freely finds its way into the water, to the greatest depth from which the plummet ever brought up a bit of living weed, or a shell containing a living animal, or indeed "deeper far than plummet ever sounded;" nay, it is not impossible that the air pervades the whole mass of the globe, liquid or solid, to its very centre.

The manner in which animals and plants, of different classes and habits, make use of the air, varies so much, that the explanations can be best given in the accounts of the creatures themselves; but it may be stated as a general truth, to which there is no known exception, that all of them, in respiration, or in that process which answers the same purpose, use the air itself, and do not, by that process at least, elaborate it, or any of its ingredients, out of other substances. It may be used rapidly or slowly, the quantity may be great or it may be small, and these will always be found connected with the general activity of the other systems in the animal; but still it is air that is wanted, and it is wanted to some extent, at least, for every living creature, plant, or animal. If the creature lives on land, then the air is taken into the lungs of the animal; and the plant may be considered as possessing lungs all over its living surfaces; and though it is not made out that there is a respiratory system within plants, any more than that there is a circulating one, still there is air in the interior of most plants, perhaps of all; and they may absorb or otherwise act upon that air at the coats of their vessels just in the same manner as the coats of the arteries in buds, are understood to act upon the air in the air-cells of these.

In the respiration of animals, whether of the land or the water, it is understood always to be the oxygen of the air which is the efficient ingredient, not for the purpose of adding any thing to the substance of the animal, but for removing the superfluous carbon, or superfluous carbon and humidity. Now the separation of oxygen from water, or, in other words, the decomposition of that liquid, supposing it to take place at a rate not more rapid than that at which the majority of fishes breathe, is rather a formidable operation; and if all the animals that are in the sea were to obtain air in that way, they would boil themselves in a very short time. These animals it is true receive the current of water through their gills when free, or in and out of their gill-openings when not free. But the water is in all cases, at least of animals in which the organisation is much developed, merely the vehicle which conveys the air to the organs in respiration, just as nitrogen appears to be the vehicle which conveys oxygen to the lungs of those animals which breathe free air; and that the water in time becomes unfit for the respiration of gilled animals, in the same manner as the residuum of breathed air becomes unfit for respiration by lungs, is a farther proof that the oxygen is obtained from air contained in the water and not from the water itself. If the water were decomposed, the liberated hydrogen would escape and the water would remain breathable by fishes as long as a drop remained. But it is found by direct experiment, not only that water which has been deprived of air will not support the life of fishes, but that if they are kept in a still vessel containing only a small portion of water they languish and die, if the water is not from time to time changed.

These facts show that the agitation of the waters, and the rolling and tumbling of their surfaces, which are produced by wind and other causes, are not without their uses to the aquatic tribes, any more than the changes of air which are produced by causes nearly similar, or at least something analogous, are to the inhabitants of the land. Fishes which are kept in small and sheltered ponds, even where they have abundance of food, (as is proved by the greatness of their increase and the rapidity of their growth,) are, when they are allowed to increase beyond a certain number, subject to general and fatal diseases, the causes of which have never been very satisfactorily explained; but which are, no doubt, in part owing to the over abundance of fishes exhausting the air in the water faster than it can be replaced by absorption at the surface of a sheltered and tranquil pond. It has been found that a pond through which there is a considerable run of water will support in health a larger stock of fish, even though the water comes into it in such a way as to preclude the possibility of its bringing any supply of food. Indeed, in those cases of mortality among pond fishes, it does not appear that want of food is any part of the cause; for they take place under circumstances where there is every reason to conclude that the supply of food is peculiarly abundant. The fishes in the overstocked pond, bear some resemblance to the prisoners in the black hole at Calcutta; and additional feeding, by increasing the action of the system and quickening respiration, would only increase the calamity.

Of streams and rivulets, flowing through earth of nearly the same composition and containing equal quantities of water, that which consists of a succession of pools and rapids is always much more abundantly supplied with the more delicate fishes than that which flows sluggishly; and the trout of the former, in point of the quality of their flesh, bear nearly the same relation to the trout of the latter, that beeves and sheep fed on an open hill side, bear to those which are fed in low, damp, and shaded pastures. The cattle are the larger in size, but they are deficient both in flavour and in nutriment. The pool under the driving rapid or the dashing cascade, is always a good trouting pool; and that not merely when it is a difficulty or a *ne plus ultra* in ascending; but apparently from the abundance of pure air with which the water is charged.

The effects of prolonged calms at sea upon the finny inhabitants of that element, have not been observed with sufficient attention; but so far as observation has gone, the fishes, especially the quick respiring fishes which inhabit near the surface, such as the herring and the mackerel, become languid and do not feed so readily when the water has been long still. The shoals of cod also "come up" in long calms, and whiten the water and even the sky with their "blink," much more than when the surface is agitated.

In proportion as the respiration of fishes is slow, they seem able the better to endure a diminished supply of air in their watery element; and their capability of bearing the diminution is always in proportion to their tenacity of life when out of the water, and also to their power of resisting impure substances with which the water may be impregnated. As soon as the water is foul, even though the foulness is only a scum of oily matter upon the surface, the salmon and the trout depart; the flounder and the gudgeon remain a little longer; and the eel continues to wriggle for its existence even after the muddy stream has become filthily impure. How much of the cause may depend on the limited absorption of the air which is in the water, so that the fishes are suffocated for want of breath, or how much must be attributed to the direct application of deleterious matters to the gills, or other parts of the fishes, where they are absorbed and act as poisons, has not been accurately determined, though it is a point of some importance in the economy of the waters.

The doctrine of the air, as an element or agent of life, both animal and vegetable, is however so very extensive, some parts of it are so very obscure, and the uses of it to different species differ so much from each other, that it cannot, though one of the most important in the whole range of human knowledge, be advantageously treated at length in a popular article. In addition to what has been here said, the reader will find some further explanation of the leading principles in the article PHYSIOLOGY; as well as in the general article on plants, and the primary divisions of animals.

AIR-BAG (called also the *air-bladder*, the *sound*, the *swim*, and various other names), an organ with which fishes are very generally provided, and respecting the use or mode of action of which there are many theories and conjectures, but none that are absolutely certain, either as to what is its use, or whether that use, whatever that may be, be uniform in all the species which have it. The common theory is, that it assists the fishes which have it in adapting their specific gravities to different depths of water, and the consequent pressures to which they are subjected at those depths; and the arguments in favour of this theory are, that those fishes which have it not are generally less discursive, both as to depth of water and to range in distance, than those which have it; that when it is punctured the fishes remain at the bottom, while so long as it is entire they can come to the surface. These arguments are not, however, conclusive, or even very plausible. We know of no animal which raises itself by balloons, whether in the air or in the water; and those fishes and reptiles which have the power of inflating their integuments, certainly never use that power to aid them either in swimming or in flying.

The fact is, that this mechanical theory refutes itself, and never would have been adopted if the parties adopting it had not been ignorant of those very principles of mechanics of which they concluded they were making a proper application. If the air-bag were of such dimensions as that the bouyancy produced by it could have any effect on the ascent of the fish to the surface, it would destroy the fish's command of itself in the water to a much greater extent. Besides, the air-bag has not been proved to be muscular, or possessed of a contractile structure; and the reddish bodies which are sometimes attached to it are organs of secretion. The air contained in the bag is chiefly nitrogen, with a mere trace of oxygen in fishes, such as the mullet, which live near the surface, but with a little more oxygen in the fish which inhabit at a greater depth. In no known case, however, has the quantity of oxygen been found to be equal to one tenth of the whole. This composition precludes the possibility of supposing that the contents of this vessel can be atmospheric air. As little are they the remains of the air after having been breathed by the animal; for the chondropterygii with fixed gills, which are the only fishes that receive the air into cavities in the body, have no air-bladders. And yet, if it were the residuum of air taken in from the water, they are the ones in which we might expect to find it, as the fishes with two gills pass the water in a current through these. When there is any connexion of the air-bag with any of the systems of the animal, it is always with the alimentary system, the gullet, the stomach, or both; but there is often no perceptible communication even with these, and when there is not, the air-bag is always furnished with glandular appendages *presumed* to be for the purposes of secretion, though, as in some cases it has both the connexions with the gullet or stomach and also the appendages, there is doubt even upon that point of the subject. Indeed, in those cases where the ducts of communication are the most conspicuous, as with the gullet in the sturgeon, and the stomach in the herring, these ducts are air-tight, so that the bag can neither be inflated nor emptied by pressure through them. That the air contained in the bag is secreted either by the glands or the tunic itself is no doubt true, at least in those cases where there is no communicating duct; and as when there is a communication, that is always with the alimentary canal, the probability is that the air-bag is, in some way or other, connected with the digestive system, but in what way, the present state of our knowledge does not enable us to decide. Enough is known, however, to show that the use is physiological, rather than mechanical—to refute the existing theory, but not to establish a better one. Before that can be done, there must be much careful observation.

The air-bags of fishes vary much in shape, in strength, and in size, as compared with that of the species to which they belong; but till the use of the organ itself is a little better known, no conclusion can be drawn from these differences.

In the arts, the substance of this vesicle is of considerable importance. When freed from fat and other impurities, it is among the most pure animal gelatine with which we are acquainted. Isinglass is the air-bag of the sturgeon, freed from oily matter and dried; and the air-bags of cod are collected and salted in large quantities at the cod-fisheries, and well-known in commerce by the name of "cod-sounds." The air-bags of all fishes may be used for the same purposes, though some of them are much smaller than others and have the gelatine less pure. Inferior ones are, however, often sold for the genuine isinglass of the sturgeon.

AIR-CELLS, and *tubes*, in birds, are cavities in the internal membranes, and also in the livers, feathers, and other parts of these animals, some of which are of use in respiration, and others render the parts in which they are contained more strong and stiff, with the same quantity and consistency of materials. As birds have no motion of the chest in breathing, and no diaphragm, the air-cells act as substitutes; and as, in some cases at least, the coats of the arteries are exposed to the air in them, they answer some of the purposes of lungs; and the bird is enabled to continue long on the wing without getting out of breath. In some species, as for instance, in the gannet, there is a power of inflating the cellular membrane of the breast by means of a communication with the air-cells; but though the quantity of air which the cells and tubes admit into the body of the bird lessens its specific gravity as a whole, it does not appear that they are used in altering that specific gravity.

AIR PLANTS are those vegetables which can live for a considerable period of time, when suspended in the air, without being attached to the ground or any substance whence they can derive nourishment. Many plants possess this property. Thus several species of *ficus*, more especially the *ficus elastica* or Indian-rubber tree, have been known to live for a great number of years suspended in a green-house, and nourished only by the air and the moisture contained in that. Some of the aloe tribe have also been kept growing in a similar manner for a long time.

The name of air plants has, however, been more particularly applied to several members of the orchis and pine-apple tribes, which are met with abundantly in the damp shady woods of the tropical regions of America and Asia. On account of their beauty and the fragrance of their flowers, they are cultivated in these countries for the purpose of adorning chambers and balconies.

The *Tillandsia usneoides*, with its wiry stems and dense leaves, attaches itself to the trees in Louisiana, forming an uninterrupted mass, suspended in the air, which frequently extends over whole forests and completely intercepts the sun's rays.

Tillandsia xiphioides,—Buenos Ayres, is another species which grows on the bare trunks and branches of trees, its airy vegetation being frequently suspended only by a thread. It is cultivated in hot-houses in this country.

Some of the orchideous tribe are also entitled to the appellation of air plants. They constitute the greatest vegetable ornament of the tropics.

Air plants, though frequently brought to this country, have only lately been cultivated with any degree of success.

Aerides arachnoides.

AIR VESSELS. A name given to the spiral vessels of plants, or vessels with a spiral coat which run longitudinally round the centre or pith of the young branches of trees or shrubs. They are well seen in the alder and lilac. These vessels have been proved to convey the sap which serves for the nourishment of the plant, but they would appear occasionally to contain air, sometimes with a greater proportion of oxygen than exists in the atmosphere. This led some physiologists in former times to regard them as true air vessels furnishing the air contained in the leaves. The leaves, however, have been shown not to depend on these vessels for their supply of air.

AITONIA (Linnæus). A small green-house undershrub, native of the Cape of Good Hope. This solitary plant was named in honour of the late W. Aiton, Esq., of the royal gardens, Kew. Linnæan class and order, *Monadelphia Decandria.* Natural order, *Meliaceæ.* Generic character: calyx, monosepalous, four cleft; corolla, of four petals; stamina, eight, protruding; the filaments united in one brotherhood, inserted under the ovarium; style, filiform, tipped with an obtuse stigma. Fruit, a berry, containing several seeds.

AIZOON (Linnæus). A small genus of five species, under-shrubs and herbs kept in green-houses as ornamental plants. Linnæan class and order, *Icosandria Pentagynia.* Natural order, *Ficoideæ.* Generic character: calyx, monosepalous, five-parted, and persistent; corolla, none; stamina, arranged in groups of threes in the angles of the calyx; styles, five, on a pentangular capsule of five places, and opening by as many valves.

ALABASTER. There are two kinds of stone to which this name is commonly applied. The first of these, the carbonate of lime, was much used by the ancients. It is nearly as hard as calcareous spar, and its specific gravity about 2,700.

This species is found encrusting the roofs, walls, and floors of caves, particularly those situated in limestone rocks. It is formed from water holding carbonate of lime in solution; and when the water first escapes into the air, it is capable of holding in solution a large quantity of that earthy body; but when the solution comes to be agitated, or exposed to the atmosphere, or to a change of temperature, the carbonic acid makes its escape, and thus deprives the water of its solvent power. Water thus impregnated with carbonate of lime oozes slowly through the fissures of the rocks: there some time elapses before a drop of sufficient size to fall by its own weight is formed, and in this interval some of the solid particles are separated from the water, owing to the escape of the carbonic acid, and adhere to the roof. In this manner, successive particles are separated, and attached to each other, until a *stalactite* is formed. If the percolation of the water containing calcareous particles be too rapid to allow time for the formation of a stalactite; the earthy matter is deposited from it after it has fallen from the roof upon the floor of the cave, and in this case the deposition is called a *stalagmite.* In some cases, the separation of the calcareous matter takes place both at the roof and on the floor of the cave; and in the course of time, the substance of each deposition increasing, they both meet, and form pillars, often of great magnitude, and which appear to have been originally destined to support the roof of the cave.

Caves of this kind occur in almost every country. Macalister's Cave, in the island of Skye, and those in the limestone hills of Derbyshire, are the most striking appearances of this kind hitherto observed in our island. But the most celebrated stalactitic cave is that of Antiparos, in the Archipelago, which has been particularly described by Tournefort. Similar caves occur in Germany, France, Switzerland, Spain, in the United States of America, and other countries.

In many places springs at a high temperature rise out of the ground, of a greyish white colour, occasioned by a quantity of gypsum, or chalk, which they hold suspended in a state of half-solution. In proportion as these grow cool, and loose their carbonic acid, the earthy particles are deposited, leaving the channels through which they flow covered with a compact alabaster, of a dazzling white colour.

The most remarkable spring of this description in Europe is situated on a mountain, near Radicofani. It supplies the baths of St. Philip in Tuscany, and forms the source of the little river Paglia. Advantage has been occasionally taken of this circumstance to obtain very beautiful impressions of bas-reliefs, by exposing the moulds to a current of such water, till they have become filled with the earthy deposit. The hardness of the alabaster depends upon the degree of obliquity at which the mould is placed to receive the dashing of the water. The more vertical the position, the harder the alabaster. The hardest models not being so white as the softer, the water is frequently caused to make a circuitous course before it reaches the mould, that all the grosser particles may be previously deposited. Even the softer ones, however, are as hard as Carrara marble, and surpass it in whiteness. The time required for these productions varies, according to the thickness, from one month to four. When the mould is sufficiently filled and the ground of the model has acquired a thickness capable of supporting the figures, the whole is removed from the water; the wooden supports are broken by gentle strokes of the hammer, and the incrustation on the outside of the mould is chipped off by repeated strokes. The brilliancy of the models is completed by brushing and rubbing them with the palm of the hand, when they become semitransparent and very beautiful.

The *sulphate of lime* forms another species of alabaster. The most beautiful white varieties of granular gypsum are selected by artists for statues and busts: the variegated kinds are cut into pillars, and various other kinds of ornaments. Those varieties that contain imbedded portions of selenite, when cut across, exhibit a beautiful iridescent appearance, and are named *gypseous opal*. In Derbyshire, and also in Italy, the very fine granular varieties are cut into large vases, columns, watch-cases, and other similar articles. If a lamp be placed in a vase of snow-white translucent gypsum, a soft and pleasing light is diffused from it through the apartment. It is said that the ancients being acquainted with this property, used gypsum in place of glass, in order that the light in their temples might be softened and harmonise with the place. The *phengites* of the ancients would appear to have been foliated gypsum. According to Pliny, it was employed instead of glass in windows, on account of its translucency. Alabaster is employed in agriculture, but its most important use is in the preparation of stucco. See Gypsum.

ALABES. A genus of Malacopterygeous fishes, of the Apodal division, or those without ventral fins, and of the natural family of *Anguillidæ*, or "eel-shaped" fishes. Only one species is known. It is small in size and an inhabitant of the Indian seas. In its general shape it resembles the rest of the family; and its distinguishing characters are the pectoral fins moderately produced, the rudiment of a gill-flap united to the skin on each side, and but only one gill-opening—a small hole under the throat.

ALANGIUM. A small genera of plants containing two species, but of so unique a structure that it forms an order of itself. Linnæan class and order, *Icosandria Monogynia*. Natural order, *Alangieæ*. Generic character: calyx, of six or eight teeth; corolla, six or eight linear petals; stamina, from ten to twenty-three. Fruit, a berry, crowned by the teeth of the calyx, pulpy, having three seeds enclosed in hard cases. They are natives of India, consequently require the temperature of a stove.

ALATERNUS. A species of Buckthorn, and one of the commonest evergreen ornamental plants in our shrubberies. The flowers are inconspicuous; but the dark green glossy foliage, resembling that of myrtle, is always admired, more especially as the foliage harmonises well with architectural forms. There are nine varieties.

ALAUDA—Lark. A most interesting genus of birds, usually classed in the graminivorous division of the passerine (sparrow-like), or small birds; but not living exclusively upon vegetable matter, they are field birds, feeding and nestling on the ground, rather in open places than where there is much cover, and rarely, and that only in some of the species, perching upon trees. They are mostly singing birds, clear, brilliant, and cheerful in their notes; and as they in general sing while hovering in the free air, and begin early in the season, when the odour of the fields is peculiarly grateful to the sense, they are greater favourites and more protected than many other birds which have more beauty in their plumage.

And they merit the esteem and protection which they receive from the country people, not only on account of the gentleness of their manners and the sweetness and enlivening character of their songs, but from the actual services which they render to the cultivator, in the destruction of both animals and vegetables which are injurious to him. These are, during the nesting time, earth worms, earth larvæ, earth insects; and also the winged ones, when they alight on the roots of plants for the purpose of depositing their eggs. At this time, the larks live dispersedly; and as they are very numerous they are found in all parts of the world where the surface is covered with succulent vegetation, but not on the heath-clad wilds or in the forests. The zone of green fields is their peculiar pasture; and although they scatter themselves far and wide during the season when they have their broods to rear, they collect in very numerous flocks in the winter.

Though often described by authors as "migratory" birds, they are not so in the proper meaning of the term. They have not, like the warblers, or the swallow tribe, a distinct and distant movement in latitude toward the pole with the stimulus of the vernal heat; and toward the equator as that stimulus diminishes in the autumn. They disperse, as has been said, in the spring; and, in autumn, they move centrally, or collect in those places which preserve their verdure, and are not subject to be covered with snow, or rendered miry by the stagnation of the winter rains.

During the flocking time they are of great service to the agricultural lands, whether these are under pasture, in stubble, or in winter crop. On the loamy pastures, where earth worms are abundant, and not only injure the ground themselves, but encourage the breed of moles, whose operations are still more deforming and destructive, they arrive about the time that the earth worms begin to pair; and as the worms are then much above ground, the larks capture them in great numbers, and thus prevent the broods; and this destruction of moles' food operates a corresponding diminution in the increase of moles. When the worms retire downward from the cold, the larks resort to vegetable food; and are of vast service in picking up the seeds of plants which are equally injurious to arable and to pasture lands. Even the grains which are left in the corn-fields would both exhaust the ground and contaminate the succeeding crops; they could not be gathered by man, and therefore, if the larks and other birds, which flock during the winter months, did no other service, they would in this be very beneficial to the cultivator.

But on all cultivated lands, whether they are in meadow or under crop, all the annual plants which are not purposely sown by man are injurious to him, as every such plant, which grows, whether in his grass meadow or his corn land, diminishes the return which he wishes to the full amount of its vegetable action. Now most of the injurious weeds are either annuals, and in the state of seeds during the season of repose, or they have annual stems, and die down to bulbous or other roots in the winter; all of them containing succulent, albuminous, or farinaceous matter—matter on which birds love to feed. The larks and other analogous genera pick up the seeds in countless myriads, and there are other races, such as the rooks, which attack the roots; and but for these, the labour of the husbandman would be more than doubled; and the best meadow could not be kept as valuable grass longer than a few years.

The larks have sometimes been confounded with the pipits (see ANTHUS), but though both are ground birds, the form of their feet, and the surfaces which they chiefly frequent, are different; the bill of the pipits is also much more slender, and less adapted for seizing worms or bruising the husks of seeds. The bill of the larks is intermediate in its form between those of the birds which feed more exclusively on insects, and those which feed mostly on seeds; their wings and tails are of that form which suits fully as well for ascent and descent as for straight-forward flight; and the form of their feet is peculiar, and as such may be taken as their best distinctive characters. See CLASSIFICATION, NATURAL, and AVES (Birds), for an explanation of the properties on which characters should be founded; and the use of them in the distinguishing of species, and determining their habits.

The following are the characters of the genus *Alauda*, which vary more or less in the different species:—

Bill, of moderate length, straight, pointed, subconical, the mandibles of equal length and without any notch, the upper mandible with a culmen or ridge advancing more or less on the forehead; the nostrils basal, of an oval shape, and defended by small feathers and hairs which are reflected forwards.

Feet, with the tarsi rather long, three toes before and one behind, all free and articulated on the same plane, so as to act equally in walking; the claws strong and very little crooked, long, especially that on the hind toe, which is called the spur, and from which the word *larkspur* becomes the name of an appendage of similar shape.

Wings, of moderate length, rounded, the third quill being the longest, and the first shoot sometimes rudimental; the tail strong and expansible.

These are the three generic characters of birds as connected with the three grand functions of feeding, walking, and flying. There are some other peculiarities that are sometimes mentioned, such as the feathers on the head produced so as to form a short crest, which is erectible. But the production or non-production of feathers, unless they are flying feathers, that is, unless they belong to the wings or the tail, cannot be made *generic* characters, though they may be *named* as such; and colour is a doubtful one even in the same species, for there have been black and also white individuals of the common lark.

The foot, of which the following is a representation,—

Foot of the Skylark.

is the leading generic character of the larks, and it is a very good indication of their haunt when not on the wing. Its principal functions are walking, and assisting the bird in mounting when it takes the wing; and it is a foot adapted for walking upon peculiar surfaces, namely, those that are uneven or elastic, but not wet—as, among the clods of a ploughed field, or on the grassy sod; but it is not, in general, adapted for perching or clutching in any way; and hence, though some of the larks do sometimes alight on trees, they do not perch there so as to hold their balance and feed, they rather stand, and use the tree as a resting-place, or post of observation. The freedom of all the toes, and their articulation on the same plane, enable them to act equally on all sides; and the long claws are stiffer, and the points of them can be moved more rapidly by the same muscular exertion, than if the phalanges of the toes had been longer and the claws shorter. The claws are levers turning on centres, the one which is pulled not being more than one-twentieth part of the other; and thus whatever velocity the muscles give to the *proximal* end which they pull, the distal end must move twenty times as fast, and thus act against the grass or other surface from which the bird rises with about 400 or (20^2) times the force. The feet of the larks thus can act something after the manner of bows, by which means the bird is, as it were, shot up into the air. They are further assisted by the elasticity of the grass or other surface of the sod, or its resistance to being bent, which in all elastic bodies, indeed in all bodies whatever, increases with the velocity of the body which tends to bend them.

The foot of the lark is thus a subject of very interesting study in the structure and mechanical action of animals; and we can trace an analogy with some of the mammalia, as in the horse, and several of the ruminating animals, and also in the great kangaroo of New Holland, all of which have natural pastures resembling those of the lark, and all leap from a long hoof, single or divided. For some account of the species, see the article LARK.

ALBATROSS (*Diomedia*). A genus of web-footed birds, belonging to Cuvier's subdivision of *longipennes*, or "long-winged birds;"—those which are much on the wing, fly discursively over the ocean, and find their food chiefly upon its surface. In some of their characters the birds of this genus resemble the GULLS, and in others the petrels; but they have enough of peculiarity to constitute them a distinct and well-marked genus, as well as a singular and interesting one.

They are by much the largest in size of all the birds which are *pelagic*, or range over the wide seas, and they are probably also the most discursive. Their proper localities are the polar portions of the great ocean, especially the Antarctic, or southern ones, where the sea bears so much greater porportion to the land than in the same latitude of the northern hemisphere; but the northern part of the Pacific also contains great numbers of them, as that ocean widens much sooner and more extensively in the line of their tropical migrations than the Atlantic. Even in the winter, the time when they are pelagic or discursive, they do not reach the centre of the torrid zone except as wanderers; though in that respect, too, they are more abundant on the Pacific than on the Atlantic. As is the case with all pelagic birds, they congregate in the breeding time; and as they congregate toward both the south and the north, some of them (even of the same species) breed at opposite times of the year; in November and December in the south, and in May and June in the north. Their generic characters are:—

Bill long, very stout, sharp in the tomia, or cutting edges, compressed, straight for the greater part of its length, but much hooked near the tip of the upper mandible, with a truncated point to the lower, exactly fitting the hook. The upper mandible is much furrowed, and channeled to the top by the nasal groove, in which the openings of the nostrils are placed nearly in the middle of the straight part, they are tubular, laterally closed, and open in front; but the nasal tubes are separated by the culmen, or ridge of the bill, and not united as they are in the petrels. The bill is thus a very powerful fishing instrument, as well for prehension as for cutting and tearing. The peculiar way in which the truncated part of the lower mandible slides upon the truncated portion of the other, produces an action much more powerful than that of any two edges of a bill, how hard and sharp soever, that merely shut against each other.

Feet, having the characters of walking and swimming feet combined; the tarsi are short but stout, and the tibia are naked a little way above the tarsal joints, which are formed like those of walking birds rather than swimming ones. The toes three, turned to the front, webbed for their whole length, with short but rather crooked claws; the hind toe wanting, or merely rudimental. The feet are thus better adapted for walking on land, or for tipping the water while the bird is on the wing, than those of the swimming birds properly so called.

Wings, very long and narrow, wedge-shaped in their terminations, the first quill being very short, and the second shorter than the third; but, though rather narrow, the wings are hollow, and take a very powerful hold on the air. The tail is well fortified by coverts, but short and wedge-shaped.

The form of the body partakes more of that of the air birds than of the swimming ones; but, notwithstanding the great length of the wings, the body is not shaped like that of the birds of most rapid flight. The habits correspond; for the birds are not so remarkable for the rapidity of their progress as for the length of time that they can remain on the wing.

They are very voracious as well as indiscriminate in their feeding; and fish even of the weight of four or five pounds, the floating spawn of those fishes which commit that substance to the mercy of the wide sea, and the various mollusca and other animals which are found at the surface of the ocean, are all received by the capacious gullet of those birds. When they fish, the skuas (*lestri*) can, by driving at them as they do at the gulls, make them deliver up the contents of their stomachs; but, in general, when the birds are taken, their stomachs are filled with gelatinous matter, rather than with even the remains of animals, though not with pure oil like the stomachs of the petrels.

There are several species; though, as was the case with even the most common of the gulls till very lately, the same bird, in the different stages of its plumage, may have been described as different species. As might be expected from the sources of our information respecting these birds, much exaggeration exists, both as to their size, strength, and cry: thus Cuvier very gravely tells us that their voice resembles the braying of the ass; on the contrary, we are assured by individuals who have heard the cry of full grown birds, when within a hundred yards of them, it consists of a sort of piping clang, rather deeper than that of the goose.

The largest species, and the one with which we are best acquainted, is

Common Albatross.

The Common Albatross (*Diomedia exulans*), which is also called the "wandering albatross," the "man-of-war-bird," the "Cape sheep," and a variety of other names. The distance from land at which these birds are met with, their great size, the contrast which their white colour forms with the sea and the sky, and the length of time that they will follow a ship, apparently always on the wing, and without ever reposing, or even alighting, cause them to be particularly noticed by sailors.

They are the largest of water birds, both in the weight of the body and the extent of the wings. They vary much, however, in weight, in lineal dimensions, and also in colour. Some of them, when lean, do not weigh more than twelve pounds; others, when fat, weigh as much as twenty-eight pounds. The length is less than that of the wild swan, which averages about four feet and a half, but the difference is in the neck of the swan; and while the wings of the swan rarely, if ever, exceed seven feet in extent, those of the albatross vary from ten to thirteen. The naked parts of the feet are dull reddish brown, the bill pale yellow, and the general plumage white, with reddish grey on the head, a few bluish feathers in the wings, and some hues of black or dusky brown across the back; but the plumage varies much; the reddish tinge on the head is most probably an indication of the breeding plumage; and the mottling on the body an indication of the immature bird. Information upon these points, as well as upon many others in the history of these very singular birds, is, however, very much wanted.

The general flight of the albatross, as it skims over the surface of the ocean in quest of its food, is not only singular, but singularly beautiful, and tends to render somewhat ludicrous those appeals which have been made to the bird, as one of the most wonderful instances of muscular exertion. Now the albatross appears to make less exertion in flying than almost any bird with which we are acquainted, not excepting the common kite, when it hovers, and even when it "gives itself to the wind;" and the only ground of wonder is, how a bird of so much weight can keep itself up with so little apparent labour. When the albatross rises, it tips the water a few times with its feet, striking with the wings at the same time; but when it has "gained its height," which in its ordinary fishing is not great, it will glide about for miles without almost any apparent motion, save the elevation of the external wing, and the depression of the internal one, when it turns. From the attitude of the body and the form of the wings, the air passes under the bird in the form of a wedge, and by that means exerts an upward pressure from its elasticity, which increases with the velocity of the bird; and the ascent of vapour *may* assist, as all birds which skim the surface of the water appear to do so with more easy wing than those that skim the land at the same elevation. At sea, too, the birds have more completely the use of the air, as even the common surface of the earth offers more friction, as is seen by the diminution of a wind from the sea, or even from a lake of moderate dimensions, as one recedes from the shore. Thus, if the pelagic bird has to range further than the bird which beats the surface of the land, its journeys are performed in a more easy manner.

When feeding, in calm weather, the flight of these birds is low, and they repose on the surface far from land; from which circumstance it is that they have got the name of Cape sheep. On their excursions to the feeding grounds, their flight is much higher, and so it is also when the weather is stormy; on both of which occasions they make more use of their wings, and become so exhausted, especially in rough weather, that they alight on the rigging of ships. In both of these cases the birds are deprived of the wedge-shaped current of air under them; and hence, in part at least, their greater fatigue.

When pelagic, the albatross captures numbers of the surface fishes, as well when they come naturally to the surface to feed as when they are forced out of the water by their enemies; as the flying fishes are, by the coryphene especially, the passage of which through the water is so rapid, that they cannot escape from it by swimming; and the moment that they are on the wing (or rather the fin) the albatross makes prize of them. When on the shores, which is chiefly in the high latitudes, their grand fishing stations are at the mouths of rivers, where there are always numbers of fish of moderate size; and there they attend and seize the salmon which leap in order to escape from the porpoise and those other enemies which follow them up the estuaries.

But though the albatross be thus voracious and successful against the finny tribes, it is rather a timid bird in the air. The sea eagles kill it, the skuas rob it, and the larger gulls attack it. When it meets with abundance of food, it gorges till it is almost stupified, and dozes on the water; and when alarmed in that state, it discharges the contents of its stomach, after the manner of the petrels, apparently for the purpose of lightening itself, both in a physical and physiological sense. When wounded, or on the ground, or even in the water, they make a powerful defence with their formidable bill.

As is the case with most of the tribe, the female lays but one egg. It is placed in a rude hollow of the earth, not high above or distant from the water, and not in a hole like the eggs of the petrels; the egg is white, very large, and of singular shape, being much elongated, and both ends nearly of equal thickness. The time depends somewhat on the latitude; being in September (which answers to March with us) on the coasts of South America; but farther into the antarctic summer, in places nearer the north pole. The eggs are eatable, though, as is the case with those of most sea birds, they are not very good; the white is said to consist more of gelatine than of albumen, and on that account not to coagulate or harden, when boiled. The nests are in lonely or desert places; and in those places of the northern hemisphere where they do breed, they appear to do it rather early in the season, as by Midsummer they resort to the northern bays and estuaries. On the east of America there are hardly any, but between the north-west of that continent and the opposite coast of Asia they are very numerous, but at first in very lean condition. Food is plentiful then, however, as June is about the time when the inhabitants of the northern seas are in full activity, so that they soon get fat; and a bird which weighed only twelve pounds in the middle of June, will weigh twice as much in the course of one month. They are easily caught with a large hook, and almost any bait, for they pounce upon and swallow with avidity any thing they see floating, if their gulp, which is a very large one, will take it in. Their flesh is hard, tough, and unpalatable, and not eaten by even the rudest tribes; but sailors, when they have been long in the polar seas without much provisions, contrive to eat them, after skinning, steeping them for a time in sea water, and cooking with pungent sauces. The wing bones are the chief attractions to the people of the northern shores and islands. They are very long, hard, and tubular, and so adapted for many purposes in the rude economy of people whose chief dependence is on the sea, and to whom bone is, in a great measure, a substitute both for wood and the metals.

There are several other species mentioned by authors, one of the best known of which is *D. fuliginosa*, or the "quaker bird" of the sailors. It is brown, with the bill, head, and tail white; but too little is known of the history of the birds for enabling us to speak with precision as to what may or may not be distinct species. The quaker birds have been described as inhabiting more polarly than the one we have described; as seldom appearing without the antarctic polar circle; and as breeding socially, or in numbers together, about or near the middle of summer. But in all parts of the world, and in respect of all the species, whatever may be their number, we do not know the whole year's history of a single albatross; neither do we know the changes in the colour of the plumage, or the beak and feet (which in many birds changes along with the plumage,) of one individual, from the time of its leaving the egg to its full maturity.

Nor can we implicitly depend on the additions that have been made to the natural history of the high seas by the continental naturalists; for, though the voyagers of that part of the world have, till of late years, probably been more attentive to natural history than British voyagers, yet they have been deficient in experience, inasmuch as they have much more rarely visited remote parts; and as they have thus seen the animals, whether birds or others, in a more transient manner, they have stood in more danger of multiplying the changes of a single species into different ones. It has been too much the custom with mere compilers among ourselves to adopt the notions of those foreigners, with some few conjectural or rather random variations, in order to give an air of originality; and hence upon many subjects which, like the albatross, involve curious points in the natural history of the globe, many errors have crept in, much to the disadvantage of the student.

ALBIN. A variety of the mineral called APOPHYLITE, which see.

ALBINOS, literally *white*, a name which was first used by the Portuguese, in their voyages to the coast of Africa, as expressive of certain individuals whom they found among the negroes there, having the same features as the other negroes, but with white skins, white hair, and red eyes, and for these reasons forming such a contrast with their swarthy countrymen, as was well calculated strongly to draw the attention of strangers, especially in an age during which interprise and superstition were both equally energetic. Dampier and his attendants also found Albinos among the red men near the isthmus of Darien, bearing nearly the same relation to the rest of the tribes there as those of Africa bore to the rest of the negroes. Subsequent observation has found them in most parts of the world, though much more abundantly in some than in others. In all places, they have the average features of the rest of their countrymen; but in all countries they have nearly the same colour, or rather the same absence of colour, a pale and death-like white, without tint or bloom of any kind.

Albinos occur most frequently in the tropical regions of the world; as on the coast of Guinea, in Ceylon, Sumatra, and Java, and the intertropical parts of America. As the latitude increases they are comparatively few; and there are no notices of any among the people of the extreme north. It does not appear, however, that the heat of the climate is the chief, or at all events the only cause of their occurrence; for, among the European ones, two, who exhibited themselves in England many years ago, and gained as much money by so doing as enabled them to establish themselves comfortably in their own country, were natives of the cold mountain valley of Chamouni, on the shoulder of Mont Blanc, not far from the perennial icebergs. In such localities they are, as has been said, rare; while in the tropical parts both of Africa and America, they are, in some places, so numerous that they have sometimes been described as a separate race. That, however, is incorrect; and it does not appear that there is any hereditary tendency in albinoism, although it appears to be much more numerous among the old residents than among migrants. Farther, it does not appear that albinoism is produced by or in any respect much connected with disease of any kind, or unhealthiness of climate; for the races among which it is most common are they who can best stand the climate. Indeed, when we would ask for a natural cause for the appearance of those very singular beings, we find ourselves utterly in the dark; and almost the only rational conclusions to which we can come is, that the darker the *aborigines* of any country, and the more equinoctial the climate, albinos are the more numerous. Buffon's notion that it is the "primitive colour" of the human race, to which they are making constant efforts to get back again, is as absurd as the other attempts at philosophy in that eloquent misleader in natural history; and would not be worthy of notice, if his very fascinating, but very faulty, book were not still to be met with in the hands of the ignorant.

The other theories, which claim to be rather more philosophical, are also without any thing like demonstration. The colour of the albino is the colour of death, before decay has begun to spot its chalky whiteness with the prints of corruption; or it is that colour which the body assumes when the owner stands aghast in the extreme of terror, or is, according to the common saying, "dead with fear." There are many well-authenticated instances of extreme terror, or extreme agitation, or grief—all of which have in some measure similar effects, turning the hair white, and not white merely, but silky, like that of an albino, in the course of a single night; and that, too, without any injury to their general health, or without any more than hereditary tendency to turn grey-haired on the part of the individuals so affected. In consequence of this, it has sometimes been supposed that albinoism is the result of fear, agitation, or some other powerful action of the passions in the mother; and though these matters lie beyond the reach of demonstration, there is no doubt, that at certain stages of the period of gestation, the passions and affections of the mother have a powerful influence upon the child. Still, as we are ignorant, and must, from the nature of the case, remain ignorant of the mode of action in all such matters, we can use them only in a conjectural way. The device of Jacob with Laban's cattle, in procuring a "speckled and ring-streaked progeny," by means of the "peeled rods," has been sometimes adduced, but it does not properly come within the scope of the argument.

The European albinos, which have been the most open to philosophic observation, have had nothing peculiar in the cast of their features, the form, strength, or healthiness of their bodies, or the power of their minds. The only peculiarities are, the skin of the most delicate whiteness, the hair white, of silky texture and shining silvery gloss, and the irides of the eyes of a beautiful pink colour. Still there is some difference between him and the albinos of races naturally darker: the skin is not so deadly white, but has more of the transparency of lily-white living beauty than of the opaque and chalky colour of death.

The eyes of albinos of all nations are delicate, and cannot bear the light so well as the eyes of people of the ordinary colour; and though a very fair complexioned European is proverbially weak-eyed, so much so that "blind fair" is a popular expression, yet one of these can bear the equatorial sun better than an albino negro.

The most correct information respecting the structural cause of this singular variety of mankind which we have, (though it does not explain, or attempt to explain the inducing cause,) is from the opinion of Blumenbach, borne out by the dissections of Buzzi of Milan. The redness of the eyes is owing to the absence of the black mucous substance (*pigmentum nigrum*) which, in the eyes of those who are not albinos, is spread over the choroid coat of the eye and the iris; and, in other eyes, the light is always the more difficult to be borne the less abundant this pigment is. Whether the darkness of the pigment is occasioned by its decomposing the more active portion of the light which falls upon it, and thus defending the parts that are below, is rather a delicate point to be ascertained; but at all events it is probable, inasmuch as the darkest eyes are best able to endure the light, which ought to be the very opposite effect of the dark colour if there were no specific action in the pigment. These facts would lead to the conclusion that the colouring matter is charcoal, in that state in which it becomes one of the best conductors of heat; but what the peculiarity of structure may be which enables some eyes to produce this charcoal more easily and in greater abundance than others, we have not any satisfactory means of ascertaining.

Buzzi was the first who demonstrated that the colour of the skin is owing to the imperfection or the absence of one of the three parts of which the skins of ordinary human beings are made up. These parts are, first and externally, the epidermis, cuticle, or scarf-skin, made up wholly of coagulated albumen, without vascular tissue, nerves, feeling, or sensation of any kind, and in most instances fading, after a time, into scales, or other exuviæ; secondly, the mucous web, or tissue (*rete mucosum*), which consists of a coat of fibrous network, loaded with a mucous pigment, something analogous to that on the iris and choroid coat of the eye, and on which the colour and complexion are understood to depend; and, thirdly, the true skin (*cutis vera*), which consists of muscular fibres, nerves, and blood-vessels, is remarkably sensitive, incapable of bearing the action of the air without great pain, and is probably the only part of the triple integument which can be regarded as possessing life and feeling in the ordinary sense of the terms. It has been said that the epidermis has a tendency to fade off in scales, which is more or less prevented by the exudations through its pores from the parts beneath; and there is some reason to suppose that these exudations proceed, in part at least, from the mucous tissue, which is the seat of colour. The ground of that supposition is, that the darker the tint of the skin the softer in general it is, and the stronger the peculiar odour which it gives out; and that in the albino negro the skin is hard and dry, resembling, in some respects, the skin of a leprous person; and it, in a great measure, wants the odour given out by the skin of the dark negro.

The hair appears to derive its substance from the true skin, and its colour from the mucous tissue; and the colouring matter which it receives from the latter seems to increase its volume, and also to give it an unctuous feel. The hair of the Albino wants, of course, the colouring matter; and instead of being humid to the feel, it is silvery or pearly. The same may be said of grey hair, which always wants the moisture of that which retains its colour.

Though, in general, there appears to be a well-established connexion between the degree in which the mucous pigment is deposited on the iris and choroid coat of the eye, and that which it attains in the mucous tissue between the epidermis and the skin all over the body, yet there is not an exact proportion between the one and the other. There are races of people who have the skin dark, the hair deep black, and the eyes very light grey; and there are many individuals who have the skin and hair both very fair, and the eyes black; and the dark eye appears to be able to stand the light when accompanied by the fair skin and hair, as well as where these are of its own complexion.

In the production and continuance of hair upon the human subject, there appears also often to be a difference between the true skin, which produces and maintains the substance, and the mucous tissue which provides the colour; and this to such an extent, as that the yielding of the one is often accompanied by a more certain maintenance of the other. Many of those in whom the hair becomes grey at an early period of life, retain it without diminution in quantity or in growth to the very close of life; and, on the other hand, many of those who begin to lose their hair early in life, retain what remains unaltered in colour to the very last. Indeed, so well marked is the distinction between those cases, that it is a common saying, that the grey man seldom becomes bald, or the bald man grey. There have also been instances of individuals in which the true skin was incapable of producing hair at any period of life; but in them the mucous tissue appears to have been imperfect, as they have been usually of fair complexions and weak eyes, with a reddish tinge on the iris; and those also upon whom hairs are comparatively few and rudimental, have been generally fair, and the few rudimental lines have been white.

That albinoism is owing to the want of the mucous tissue is further proved by the results of those wounds in the skin by which that tissue is topically destroyed. A surface wound upon the finger, especially if it be kept in a state of irritation for some time, will produce a white mark on the nail, which will travel gradually along that organ, until it is cut off at the point; and if the injury has been of a very serious nature, and the irritation long continued, a derangement of the nail may be produced, which will never be removed. Galling the back of a horse also produces white hair after the wound heals, even though the colour has been originally deep black; and jockeys sometimes avail themselves of this, and by destroying the mucous tissue with a hot iron produce a white spot on the forehead of the horse, if such a mark be considered as ornamental.

All these facts tend to prove that the white colour in the albino, whether of the skin or the hair, is owing to the want of the mucous tissue; but they do not throw any light upon the cause of the deficiency, or want of that organ. One can, however, easily enough understand why albinos should be more common among people of darker complexion, because among such a people the mucous tissue is of more importance as the action upon it is greater. That, in any particular district, it takes place more readily among the aborigines than among emigrants, is a further proof of the same position; and on the same fact, it is not very difficult to ground a theory of the differences of colour that are found among the human race, supposing them all to be issuing from a single pair. See MAN.

Human beings are not the only animals among whom albinos appear. They are found among very many of the mammalia, and not a few of the birds; and where they occur, they have nearly the same corresponding colours of the skin and the eyes, and the same pain in the latter when exposed to bright light, which characterise the human albinos. Albinoism among them does not, however, depend upon the absence of the colouring influence of the sun, as it appears to do in those species which turn white during the winter; but there is no such marked diminution of the number of albinos, from the regions of the equator to the higher latitudes, among the other animals, whether mammalia or birds, as there are among the human race. Among the cold-blooded animals no albinos have been found; or at least any traces which have been observed in them have been easily referable to disease, whereas in the albinoism of the warmer-blooded animal there is no disease: but merely a deficiency of the original structure. See COLOUR of Animals.

ALBUCA (Linnæus). A family of bulbous flowering plants, natives of the Cape of Good Hope. There are nineteen species described, which are usually kept as green-house ornamental plants. Linnæan class and order, *Hexandria Monogynia*. Natural order *Aspho-*

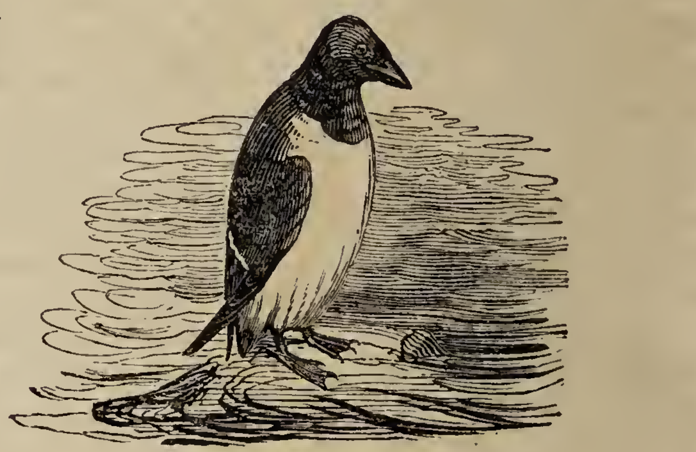
deleæ. Generic character: calyx, six sepals distinct, the three lower ones are strait and connivent, swollen and thicker at the points; the three outer are spreading; stamina, six, rarely all fertile, sometimes only three opposite the inferior petals bearing anthers. Style triangular, terminating in three points; capsule of three places containing seeds.

ALBURNUM is the name applied to the imperfect wood of a tree, that is, to the outermost layers of wood situated immediately below the bark. It is wood in a young state, having not yet acquired the hardness and compact texture which characterise perfect wood. It is also called sap-wood by carpenters, because less durable than the first-formed layers which are called, as well from their situation and hardness, heart-wood. All kinds of timber gain solidity and weight gradually. An oak tree, for instance, of twenty years' growth, if cut transversely, will present in the body of the wood twenty concentric circles indicating the age of them. Of these, twelve or thirteen will be dark coloured heart, and seven or eight will be white coloured sap-wood. Various opinions have been advanced in regard to the mode in which the alburnum is formed. Some suppose that it is derived from the bark, while others say that both it and the bark owe their origin to a peculiar fluid called *cambium,* formed by the descending sap of the plant. This fluid thickens and becomes organised, giving rise each year to a layer of bark and a layer of alburnum.

ALCA—The Auk. A genus of birds, belonging to Cuvier's first division of web-footed birds, or those which are divers. The genus has been subdivided by modern ornithologists, so as to exclude the puffin and some other species; and, as it now stands, the following are the leading generic characters: bill straight, compressed towards the tip, tip of the upper mandible hooked, that of the lower forming a salient angle. Nostrils lateral, near the middle in length of the bill, lineal, nearly closed by a membrane, and covered with feathers, as are also the basal halves of both mandibles. Feet short, placed far back, so that the birds walk upright and awkwardly. The feet, with only three toes in front, completely webbed; and acting obliquely in the water, like those of the other divers. Wings short, and, in some of the species, merely rudimental, and unfit for flight; but others fly with ease, though flying is not their general habit. It is, however, singular, and to be regretted, that Cuvier's mistake, that "their wings are decidedly too short for supporting them, and they cannot fly at all," should have been allowed to stand in the last edition of the *Regne Animal,* when the first species which he mentions, the common razor-bill (*Alca torda*) can not only fly, but fly well, is a migratory bird, and builds very high on the ledges of lofty rocks. It finds its food in the sea, and during the incubation, the male purveys for the female, while she sits at a height of several hundred feet perpendicularly above the water. To *climb* such a height, by the help of the beak and feet, such feet as an auk has, would be difficult, if not impossible. This mistake is the more singular that the species which can fly visits the shores of France, and that which cannot fly does not.

The species which can fly are not, however, air-birds; they never feed on the wing, neither is it their general habit to feed swimming on the surface of the water. They dive and feed under the water, for which their forms and their feathers are equally well adapted. During the greater part of the year they live dispersedly, scattering themselves along the shores, and to the islands which are uninhabited, and at some distance from the main land. About May, they collect to their breeding places; the wingless ones choosing the fissures and holes near the water, and the winged ones the ledges higher up; and when the broods are ready to shift for themselves they again disperse, though some are met with on different parts of the coast of Britain or its isles all the year round. In winter they are found, but not very abundantly, on the flat shores of the continent, from near Calais to the entrance of the Baltic; but they do not resort thither in the breeding season. From what has been mentioned of the male fetching food for the female while sitting, it must be obvious that the birds cannot make long journeys at that time.

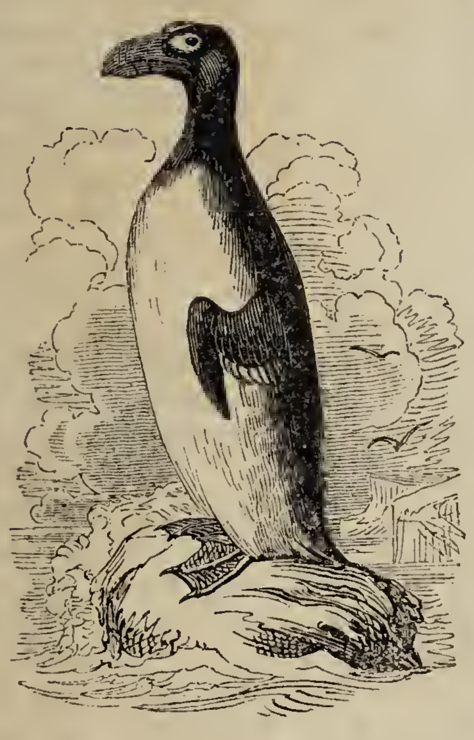
These birds, as well as all the analogous genera, have only one brood in the season, and that consists of but one individual. The egg is, however, very large, and the female is a close sitter. It should seem that the elaboration of a plumage, which shall fit the young birds speedily for diving, requires both a large egg and a careful incubation. Auks are interesting birds, but they are unknown in the interior of the country, and by no means familiar on the coasts, except at the great nesting places of the sea-birds, and these are usually the places to which there is not much resort. There are two species which may be briefly noticed. They are both birds of the northern seas, and do not, in any longitude, range far to the south.



Common Auk.

The Common Auk, or Razor-bill (*A. torda*), is about fourteen or fifteen inches in length; and, though the closed wings do not extend further than the rump, they are about two feet three inches when expanded. The tail is long and wedge-shaped, or rounded at the extremity, and the powers both of that and the wings indicate a bird which ascends and descends readily on the wing. In summer, the head, neck, and most of the upper parts are black; but there is a narrow white band in front of the eyes; the throat and upper part of the breast are brownish; and all the rest of the under parts, together with the tips of the secondary quills, are white. In winter the brown fades to white, and the blue on the upper part becomes dull and brownish. The males and females resemble each other in both plumages; and they have the bill black, with a white band in the middle. The young birds have the breast mottled with white; the white band across the eyes indistinct; the bill shorter than in the mature birds; and the white band upon it is wanting. It is a character of all the analogous genera to have the bill shorter in proportion in the young birds. The egg is very large for the size of the birds, being at least three inches in length. Its ground colour is white, spotted with black. Both the eggs and birds are rather rank and fishy; but the northern islanders, who run no inconsiderable hazards in obtaining the eggs, continue to employ them as food after due seasoning. The nicety with which the eggs of these and other sea birds are balanced on the ledges of the rocks, has led authors to assume that the birds have some means of cementing them; but the assumption needs no refutation.

The Great Auk (*A. impennis*). This is a much larger kind than the former; much more rare in its appearance, and obscure in its habits. It is sometimes seen on the shores of the more remote Western Isles of Scotland in the months of May and June; but not often then, and rarely indeed at any other season. It is a large bird, being about the size of a goose; but it is naturally a water bird, and not adapted for progressive motion, either through the air or along the earth. Its wings are only about four inches in length each, and they have no feathers at all adapted for flying, so that their principal use is in guiding its course under water. Upon land the feet are not much more serviceable than the wings are in the air. The bird cannot move, or even balance itself upon them, without bringing the whole of the tarsi to the ground, and thus it shuffles along in a very awkward manner, flapping its wings, and wriggling. It can, by the help of its bill which is very large, contrive to drag itself a few yards above the level of the water; but the operation is one of great apparent labour, and no little time. In the water, however, it is "at home," and dashes along with the ease and velocity of a fish.



Great Auk.

The bill is four inches and a half in the gape, and more than one inch and a half in depth, much couched in the culmen, or ridge of the upper mandible, strongly and firmly made, and black; it is thus an instrument capable of catching a fish of considerable size. The upper parts are mostly black on the cranium; the under, brown forwards, and white behind; and the presumption is, that it is subject to similar changes from age and season as the common auk.

The egg (there is but one) is not deposited on the ledges, as in the former species, but in a hole of the rock, or an excavated hole on the dry shore. The egg is very large, not less than six inches in length, similar in its colours to that of the common auk. The above figure will give some idea of the general shape of the bird.

ALCEDO—Kingfisher. A genus of birds of which the characters are: bill long, straight, quadrangular, pointed at the tip, sharp in the tomia,

Head of the Kingfisher.

diminishing gradually to the pointed tip, and having the height and breadth nearly equal throughout. The nostrils basal, near the sides of the upper mandible, and pierced obliquely. The tongue very short. The whole organisation of the mouth adapted for fishing rather than the capture of insects. Feet short and weak, and not well adapted either for climbing or for walking on the ground. The three front toes are united at their bases, and the exterior one is as long as the middle; the tarsi are slender and short, and the tibia lines a little above their articulations. The foot can be used in scraping and excavating the earth, but it is very awkward for progressive motion. Wings long and powerful in their motions; but the tail is short, the birds regulating their course by their long bill. The plumage is very smooth and glossy, not easily ruffled or wetted by water. The nests are in holes in the banks of those streams in which the birds seek their food. They are solitary birds in their habits, so much so that the pair are not seen together except during breeding time. They are not abundant in any part of the world, and in most places they are rare. Their variety, their quick motion, their bright colours, their peculiar form, and the times at which they are the most assiduous in their fishing, have rendered them noted birds from very early times. Those treacherous days of more than ordinary stillness and clearness of the air, which are generally, if not always, followed by bad weather have been called "halcyon days," because during them the kingfishers are peculiarly active. The birds, of course, know nothing of the coming storm; but that state of the waters when there is neither ripple nor evaporation at the surface, renders the small fishes on which the birds feed more discernible. There is only one European species. See Kingfisher.

ALCYONIDÆ. An order of birds partaking in part of the characters of the *Anisodactyli*, or unequal yoke-toed birds, and the *Chelidonia*, or swallow tribe. They agree in part with the *Syndactyli*, or second division of Cuvier's great order of Passeres; but the characters of that division are so varied, and in some instances so irregular, and the feet (especially in the *Alcyonidæ* properly so called) form so very unimportant a part of the whole character, that it is exceedingly difficult to obtain any arrangement which is either natural or satisfactory. See Syndactyli.

The *Alcyonidæ*, properly so called, or "kingfisher" birds, have the bill long or of middle size, nearly quadrangular in its section, and either straight or very slightly arched. Their tarsi are short, and their feet very unfitted either for climbing or for walking; and they have four toes, the three before united at their bases, and the hind one more or less enlarged at the base. Their wings are powerful for their size; but the tail in some of them is very short. They all prey upon the wing, some chiefly upon insects, others chiefly upon small fishes. They inhabit the banks on streams and rivers, generally in solitary places, and nestle in holes. The colours of their plumage are rich; and there is little difference in the males and the females, or in the old and young birds. Their motions are exceedingly abrupt and rapid, jerking now here now there, and making their haunts gay with the rich and strongly contrasted tints of their plumage. The style of their flight is very like that of the martins, especially those martins that catch their prey on the surface of the waters. It is on this account that the French call the kingfishers, which may be considered as the type of the order, "Fishing Martins;" but there are some which catch the larger water insects, and seldom fish, unless when their insect supply fails. See Alcedo Merops.

ALCYONITE. A name given to the fossil remains of the Alcyonium, a zoophyte belonging to Lamarck's third class, the *Carnosa*, and which is allied to the sponges. The fruit-like and spongiform fossils belonging to this class are involved in much obscurity, in consequence of the want of a satisfactory arrangement of even their recent species, their nature and structure being very little understood; for which reason a more detailed and particular account of them may be acceptable to our readers, especially as they are so exceedingly abundant, that in some situations scarcely a flint can be broken in which traces of their structure may not be detected: and also, as a condensed summary of what is known concerning these singular bodies is still a desideratum in works of a similar description to the present one.

The distinctive characters of the recent sponges and alcyonia, as proposed by Ellis, Lamarck, Lamouroux, and others, are, generally speaking, of very great nicety, such as the presence or absence of polypi, supposed to be in the former of such delicacy as to shrivel up immediately upon being taken out of the water, and thus to elude observation; whereas in the latter, they may be rendered visible under similar circumstances, or upon others equally difficult of observation, even in the living species. The most marked distinction, however, is, that the alcyonium possesses a spongy or gelatinous body inclosed in a tough cellular integument containing polypi, while the sponge presents a similar body without the fleshy covering, nor have any polypi as yet been discovered as its inhabitants.

Characters like these, as might be expected, are for the most part absolutely impossible to be ascertained in substances in the fossil state, where the solid parts of animals alone are preserved, and consequently numerous obstacles still present themselves to a complete and satisfactory arrangement of these bodies. From the fruit-like forms which they so frequently present, they were in the infancy of the science of fossiology, called by the names of those fruits to which they were supposed to have a resemblance; but their being subsequently found to have a decidedly animal structure, rendered such a nomenclature totally inadmissible; and in order to obviate in some measure the various difficulties which present themselves in the classification of these intricate fossils, various other arrangements have been suggested. In that very valuable work, "The Geology of England and Wales," by Dr. Conybeare and Mr. Phillips, it is proposed to separate the alcyonites into two divisions, the first to include those whose fibrous reticulations run confusedly together, their meshes presenting no regular determinate figure—and in the second to place those in which they are regularly disposed, giving to the whole mass a plicated character. Of the first of these divisions they form five genera. The first includes those of a branched form; those which are palmated with the larger pores arranged in quincuncial order form the second genus; the third embraces the irregularly turbinated and funnel-shaped masses, whose forms are exceedingly various, probably arising from the different contractions of the mass; in the fourth we have those which are fig-shaped, pedunculated at the bottom, and presenting a funnel-shaped cavity, penetrating in the direction of the axis, with large pores radiating from the same; and the fifth is characterised as forming large irregular sessile masses, the upper surface tuberculated and traversed by large irregular ramifying pores. In the regularly plicated division, the most remarkable is the fossil described by Mantell in the eleventh volume of the Linnæan Transactions, to which we shall shortly again refer.

Another arrangement of fossil spongiform bodies is proposed by Parkinson in his Introduction to Fossiology. He divides them into four genera, which he designates as spongia, syphonia, mantellia, and alcyonia, and proposes the following as the characteristic distinctions by which each genus may be determined. "If," says he, "a cellular texture, such as would be formed by the irregular decussation of membranous substance, can alone be traced without any appearance of tubuli, the place of the fossil would be under the genus sponge; but if in addition to the spongeous texture, straight or regularly divaricating simple tubuli should appear, its place would be under syphonia. If, whether spongeous texture appear or not, simple tubes are discovered connected laterally either by anastomosing or intercurrent tubuli, the fossil may be considered as belonging to mantellia; but should the more compact parts of the fossil or its porous substance display the evident labours of polypi, no doubt should be entertained of placing it under the genus alcyonium." The last three of these divisions are those usually included under the name of alcyonites; and to the first of these, the syphonia, are to be referred the various fossils shaped like funnels, cups, and fruits, described by M. Guettard, as found at Verest near Tours and Saumur, and also at Mont Richard in Touraine; and also those mentioned by the Rev. J. Townshend, as found in the green sand of the Vale of Pewsey, as well as many figured in the second volume of the Organic Remains. To these must be added those singular fossils discovered by Mr. Webster in the Isle of Wight, to which, from their long stalks and tulip-formed superior terminations, he gave the name of tulip alcyonia. Specimens of fossils of this genus have also been described by Miss Bennet, as found in the sand in the neighbourhood of Warminster, having a great variety of forms, as round, cylindrical, straight, ramified, oblong, cup, or funnel shaped, elongated like a cucumber, tulip-formed, being exactly like those described by Mr. Webster, and also assuming the figures of various sponges. Some are also lobated, having from two to five or six lobes closely united together upon one stem; and one specimen is described, in which two stems arise from the same base, the one terminating with three, the other with five lobes. A more particular account of these very curious and interesting fossils may be found in the Geological Transactions, and also in the description of them by Miss Bennet. Under the second genus we find the fossil before alluded to as described by M. Mantell, and the name Mantellia is given it as a compliment to that gentleman.

Of the third genus many highly interesting specimens are also to be met with, generally imbedded in flint or chalk; and, indeed, they may be said to be almost entirely confined to the chalk formation, but slight traces of them being to be met with elsewhere.

Since the publication of the works now referred to but little has been done as to the general arrangement of these fossils. The fig-shaped ones described by M. Guettard have been formed into a new genus under the name of choanites; and the genus ventriculites has been established for the reception of the fossil discovered by Mr. Mantell, and described under this name by him in his late very valuable and highly comprehensive work, "The Geology of the South-East of England;" and as the whole description is full of interest, and gives proof of the very great research for which this gentleman is so justly celebrated, we shall, for the information of our readers, give a condensed abstract of it. He describes the ventriculite as a zoophyte of a funnel-shape, having the base provided with radical fibres, or processes of attachment, the external surface reticulated, the inner covered with minute perforated papillæ. The original substance was spongeous or gelatinous, and the zoophyte was probably capable of expansion and contraction. The common species, the radiatus, has the external integument formed of subcylindrical anastomosing fibres radiating from the centre to the circumference; the papillæ on the inner surface are formed by the open extremities of short transverse tubuli. This fossil assumes a great variety of forms, and consequently it is necessary to examine a considerable number of specimens in order to form proper conclusions respecting it. Those which are enveloped in flint are usually cup-shaped or turbinated, while those imbedded in chalk exhibit a broad circular disk; the external surface presents a number of cylindrical fibres extending in a radiating manner from the centre or base to the outer margin, and by their frequent divisions and anastomising constitute a reticulated integument capable of considerable contraction and expansion. In its contracted cylindrical form it is from one to six inches in length; when expanded its diameter occasionally exceeds nine inches; the thickness of its substance is seldom more than 0·2 of an inch.

A specimen, figured in the work from which this abstract has been taken, exhibits a narrow zone of flint surrounding the wider part of the fossil (which is funnel-shaped) at a small distance from the outer edge; when, from any cause, the included zoophyte is destroyed, the ring remaining uninjured, presents the appearance of a broad flat ring, and thus affords a satisfactory solution of the origin of those broad annular flints resembling a quoit, which are occasionally found on the ploughed land of the downs of Sussex. It also leads to the singular conclusion that the silex, at the period of its mineralisation, was in the state of a thick viscid fluid, otherwise it is difficult to understand why it should not extend to the margin, instead of being consolidated in a ring at a short distance from it.

The inferences drawn from a careful examination of these fossils lead also to a very satisfactory explanation of the structure of the ventriculite when living.

Its general form appears to have been that of a hollow inverted cone, having numerous branching fibres proceeding from the base attaching it to other bodies. Externally it was composed of a reticulated integument capable of expanding or contracting according to the impressions received, and internally it possessed a surface covered with the apertures of numerous tubuli, probably the openings of vessels by which nutrition was effected. Its expanded state was possibly favourable for the discovery of the substances destined for its nutriment, which, by the subsequent contraction would be imprisoned in the funnel-like cavity, the nutritious particles being probably absorbed by the openings so numerously distributed on its surface. Whether they were capable of changing their situation by detaching their radical processes cannot now be ascertained; but it is probably that, like the actiniæ and alcyonia, they were permanently fixed to the rock on which they grew.

The alcyonite fossils are found in various situations. Those of the tubular fruit-like forms are found chiefly in the green sand. The ventriculites and other bodies referable to this class are principally met with either imbedded in chalk or in the flint which is so abundant in their formation. The diluvial gravel is also full of them. Those remarkable masses of flint found in great abundance in Ireland, and also in other places, called paramandra, have every appearance of having been formed round some species of tubercular alcyonia, which must have been of enormous magnitude. We may also state, that those singular hollow nodules, known in the days of superstition and ignorance by the name of eagle stones, and to which many magical as well as medicinal properties, such as the preventing abortion and the discovery of thieves, were attributed, have also been referred to this class. They consist of a flinty covering, probably formed over a sponge or alcyonium, which decaying, has left a cavity in the interior, the chalky, earthy, or silicious remains of which occasion the rattling heard upon shaking them. They were called eagle stones from the ridiculous opinion that they were carried by the eagle into her nest, in order to prevent the eggs from becoming addled. They are now called geodes.

After all that has been said, our readers must be aware of the great difficulty experienced by men of science in accurately classing or describing animals of so changeable a nature. As zoophytes in general are constantly in motion in quest of food, and yield without difficulty in every direction to the slightest pressure, the animals, when imbedded, might have been softly covered or rudely crushed, and thus we may account for the immense variety of forms under which they have been discovered.

ALCYONIUM, forms the fourth class of polypidoms not subdivided into orders. It includes all such as are called carnoid or flesh-like polypidoms, being composed of a fleshy mass, wholly animated, entirely covered with polypi, and possessing no central axis; they are of various shapes, having the appearance of a thick, porous, or cellular mass, spread out or ramified, sometimes lobed, and at others in the form of a crust; the interior substance spongy, or like cork, surrounded by a radiated, tubulous tegument, and enclosed in a hard leathery rind.

The cells of this polypidom are round, of various diameters, from the eighth to the fifth of an inch, separated from each other by thin partitions, rendered opaque by a great quantity of solid globules, that appear to form the least animated part of the zoophyte. Each cell encloses a polypus, composed externally of a transparent sac or membrane, strengthened by eight filiform longitudinal fibrous bands, placed at equal distances, and difficult to be perceived, owing to the presence of numerous transverse and parallel fibres. The longitudinal fibres seem attached to the borders of the cells and to the roots of the tentacula. The sac (which is capable of extending and contracting, the upper part falling back when the little animal retires within its transparent covering) encloses the body of the polypus, having in the centre a hemispheric mass, divided into eight equal parts by vertical partitions, whose summits present a round or lozenge-shaped opening, at the will of the animal, which probably forms the mouth; the borders are furnished with irritable appendages, the form of which it is difficult to distinguish. The tentacula fold over each other, and surround the globular mass, which then forms a spherical or pyramidal body.

The general envelope of the polypus rises a small way above the surface of the polypidom, and all the parts it encloses are easily observed with a good lens. The complicated organisation of the alcyonian polypi renders any description of them extremely difficult; many points of resemblance seem, however, to unite them to the animals of the harder polypidoms. This class varies much in the size of its species, some of them extend in patches of greater or less thickness on the surface of the bodies to which they adhere, whilst others raise their branches to the height of several feet. Some live on marine plants; others delight more in muddy waters, raising their animated tubercles above its surface; but the greater number attach themselves to rocks and the larger shells, which they sometimes cover with their polypean mass. They are found in all seas and at all depths; but from the difficulty attending researches into the nature and habits of these creatures, only about fifty species have been distinguished, forming probably but a very inconsiderable portion of the number existing.

This genus is frequently found in a fossil state, and the species are far more numerous than those discovered in a recent state.

ALDER-TREE. A genus of forest trees, indigenous to Britain. Belonging to the Linnæan class and order, *Monœcia Tetrandria.* Natural order, *Amentaceæ.* Generic character: male flower receptacle of the ament wedge-shaped, truncated, composed of three flowers; calyx, scaly; corolla, four-parted; stamina, four-female flowers; calyx, scaly, or two flowered; corolla, none; seed, compressed, oval, naked. The alder affects moist bog earthy soil on the banks of rivers or water-courses. Its natural habit of growth is to run up with a plurality of stems; and when trained with one, though it forms rather a handsome tree, it is not long-lifed. They are much more valuable as underwood than grown for timber, being, like the willow, more vigorous for being cut down; that is, the roots are more active in yielding supplies to young shoots than to old stems. Alder poles are much used by turners and other small ware artisans; also by charcoal burners for the manufacture of gunpowder; and when butts of good size, and sound throughout, can be obtained, this timber is highly valued for piling and planking to lie constantly under water. The bark in some countries is used for tanning, and some quality used in dyeing is extracted from the young twigs. Of the fourteen species, the heart-leaved, the long-leaved, the red, and the saw-leaved, are fit for the arborctum; and among the varieties of the common one, the fringed-leaved, cut-leaved, and oak-leaved,

The Alder Tree.

are ornamental. The common species are raised from the seed sowed on a moist soil in autumn. The curious varieties are propagated by layering—sometimes by grafting on the common.

ALDROVANDA (Decandolle). An Italian aquatic perennial, sometimes seen in British botanical collections. Linnæan class and order, *Pentandria Pentagynia.* Natural order, *Drosceraceæ.* Generic character: calyx, five cleft; corolla, of five petals; stamina five; ovarium is surmounted by five styles and stigmas. Fruit, a capsule of one place, containing ten seeds, which are discharged from five valves.

ALECTORIDÆ,—so called from that Greek name of the cock which describes him as the caller of people from their beds—a character in which he has been equally a favourite with peasants and poets in all ages,—a family of birds belonging to the order *gallinidæ*, or poultry. They are all natives of America, and dwellers in the forests of that country, large birds, and in their appearance and habits bearing a considerable resemblance to turkeys. They all have the wings short, broad, and hollow, the tail rounded, composed of strong feathers, which can be spread out as rays in a wheel. Many of them have naked skins or callosities at the base of the bill, especially in the males; and some have flexures in the windpipe at its bronchial extremity. They all perch, and most of them nestle in trees. They also feed much upon seeds, fruits, and buds. They are social, and easily domesticated; and, when in good condition, their flesh is esteemed. The following are the genera: *Crax*, the hocco, or eurassow; *Ourax*, the pauxi; *Penelope*, the guan, or yacou; *Ortalida*, the parraqua; and *Ophistocomus*, the hoazin. But the species and even the genera are confused, as they have been mixed with the European Gallinæ. They all belong to South America.

ALEPOCEPHALES. A genus of soft-finned fishes with abdominal fins, belonging to the *esocedeæ* or pike family, from the majority of which they, however, differ in many of their characters and habits. They have small scales on their body, but none on the head, which is the character on which the name is founded. They are large fishes, with small mouths, and very large eyes. Only one species is known, *Al. rostratus* (the beaked smooth head) of Risso. It is an inhabitant of the Mediterranean, a deep sea fish, and its habits are very little known.

Notwithstanding the labours of Risso and others, the natural history of the Mediterranean still wants much investigation; and there are few seas which offer a more abundant harvest to the inquirer. The circumstance of this fish, which resembles in its general structure those fishes which inhabit rivers, ponds, and the shallows, or at least not the greatest depths of the sea in other places, being not merely a pelagic fish, but a deep sea one, in the Mediterranean, is a peculiarity worthy of notice. When we further consider the numerous and varied climates, the waters of which mingle in the Mediterranean, without any outlet save the strait of Gibraltar, which is too narrow for allowing a free and rapid mingling with the great mass of oceanic water; and when we consider, also, that the Mediterranean is, in great part at least, as it were "a cauldron on the fire," from the volcanic action which is constantly going on under its bed, and which sometimes penetrates upward to the surface—when we consider these, we may expect that the living productions of the Mediterranean shall correspond with those of the sea itself. The waters from tropical Africa, from those parts of Russia which are for nearly half the year covered with ice and snow, from the temperate valley of the Danube, and from the glaciers of the Alps, all blend in the Mediterranean, and are there subjected to the action of volcanic fire; and, though there is both an outward and an inward current in the strait of Gibraltar, these are not enough to connect the water of the Mediterranean with the general circulation of the oceans. There is no other sea on the surface of the globe that has such peculiarities; and for this reason, the natural history of the Mediterranean is highly interesting.

ALEPISAURUS. A genus of Acanthopterygeous, or spinous-finned fishes, belonging to Cuvier's natural family of *Tænioides*, or "riband fishes," first communicated to the Zoological Society of London by the Rev. R. T. Lowe in 1832. There is but one known species, a native of the Atlantic in the neighbourhood of Madeira, and rare. This species is *Alepisaurus ferox*, of which the following are the leading characters. The head compressed; the gape wide, and distant from the eyes; the teeth, a single row in each jaw, conspicuous, long, and recurved backwards. The body long and slender, and both body and head without scales. Two dorsal fins, the first long and extending a considerable way along the back; the second small, triangular, and soft and fatty as the salmon. The ventral fins of medium size and abdominal; the anal fin of mean length; the caudal large and forked; the gill-flap with six or seven rays. This is rather a curious genus, as combining some of the characters of the spinous and soft-finned fishes. Its habits are little known, but from its structure it must be both voracious and formidable.

ALETRIS. A genus containing two species of perennial herbs cultivated for their flowers. Linnæan class and order, *Hexandria Monogynia.* Natural order, *Hemerocallideæ.* Generic character: calyx, corolla-like, tubular, rough; limb in six regular divisions; Stamina erect; filaments short, inserted into the base of the segments; anthers somewhat arrow-shaped; style and stigma three-sided; capsule seed-bearing, crowned with the style, three-celled, three-valved. Placenta central, seeds numerous, minute, and arched.

ALEXANDERS. See SMYRNIUM. A warm-flavoured aromatic herb, used in salads. The seed is sowed in drills in February or March; and as the plants rise, are earthed up and blanched like celery, and used in the same way. The plant is now, however, seldom cultivated.

ALGÆ. The sea-weed tribe, a family of plants belonging to the acotyledonous or cellular order of vegetables, and to the cryptogamic class of the Linnæan system.

Schizonema Dillwynii. Laminaria saccharina. Fucus vesiculosis.

This family consists of aquatic, leafless, and flowerless plants, which vary much in form and texture. They exist frequently in the form of jointed filaments of greater or less size, or of flat membranes, which are sometimes furnished with distinct stems. Their fructification consists of seeds or sporules, occasionally contained in tubercles or processes arising from the frond. They are attached to various substances, such as stones, rocks, shells, &c.; but they seem to derive nourishment chiefly from the element in which they grow, by a process which takes place over their whole surface. Some species have processes like roots by which they are attached, while others are always met with in a floating state, and seem to grow without being fixed to a spot. The general colour of sea-weeds is olive-brown or olive-green, but they are often of a beautiful red or green colour, and look well when dried and fixed on white paper. They easily become dry and shrivelled by exposure to the air, but they can afterwards be revived by being put into water. Botanists take advantage of this property in making their collections; for even although the plants should have been withered in consequence of having been gathered for a long time, they can be made to resume their fresh appearance before being subjected to pressure for the purpose of being properly dried.

In almost all moist places we find some of the species belonging to this extensive family, which includes not only the sea-weeds or *fuci*, properly so called, but also many plants which exist in fresh water. Some of these plants are found even in hot springs; thus the *Ulva thermalis* grows in the hot springs of Gastein, which have a temperature of 117° of Fahrenheit's thermometer. Under this family are included some plants of the most minute and microscopic nature, and others of the most enormous size; from the green slimy matter covering the surface of wet stones to the gigantic fuci which grow from the greatest depths of the ocean. Some of the plants are nearly allied to the lowest orders of the animal kingdom, and the gradation is so gradual that no distinct line of demarcation can be traced. The difficulty of distinguishing some of the algæ from the zoophytic members of the animal kingdom may be shown by the fact that several species which used to be referred to the former, have lately been transferred to the latter; and many naturalists have even gone the length of supposing that many of the species are plants during one part of their existence, and animals during another.

Though the plants belonging to this family are often passed over as of little importance, we find many of them distinguished for their beauty as well as their utility, contributing to the wants of man both in an economical and medical point of view. They have engaged the attention of many eminent botanists, and several valuable works have been published on the subject. We would particularly refer our readers to the beautiful delineations and excellent descriptions from the pen of Mr. Turner in his splendid work on the Fuci, also to Dr. Greville's Treatise on the British Algæ, and to the excellent arrangement given by Dr. Hooker in the fifth volume of the English Flora.

Algæ exist in all parts of the ocean, but they vary in different regions. Those found in the Mediterranean, for instance, are different from those met with in the Red Sea, while the latter do not resemble those of the West Indian Sea. Each great division has its peculiar marine vegetation, answering wise purposes in the economy of nature, and contributing doubtless in many ways to the comfort of the animals which inhabit the pathless depths of the ocean.

Some of the sea-weeds attain a great length. Thus the *Chorda filum* found in the North Seas, and growing so abundantly in some of the Orkney bays as to impede the passage of boats, attains a length of thirty or forty feet. But this is greatly exceeded by a species of Macrocystes, which is stated to have been met with in the South American seas, 1000 or 1500 feet long. This sea-weed, is of enormous length, and has much thinness of stem. It is supported in the ocean by the aid of small vesicles full of air, which nature has wisely placed at the base of each leaf.

Sea-weeds grow with amazing rapidity. A proof of this may be given in the case of the Carr Rock, a sunken rock near the mouth of the Frith of Forth, which was dressed with the pick and chisel, and completely freed from sea-weeds for the purpose of erecting a stone beacon. Operations were suspended in the month of November, and were resumed again in the month of May; and although the winter had been very severe, still the rock was found again completely covered with sea-weeds, some of them six feet long.

An object which has particularly attracted the attention of navigators, is the Gulf-weed, which consists of two or three species of sea-weeds (*sargassa*), found floating in great abundance on each side of the Equator, in the Atlantic, Pacific, and Indian oceans.. The name of Gulf-weed was given from the supposition, which has been proved to be erroneous, that these sea-plants grew in the Gulf of Mexico, and were carried across the Atlantic by the gulf stream. From the great accumulation of floating sea-weeds between the eighteenth and thirty-second parallels of north latitude and the twenty-fifth and fortieth meridians of west longitude, the Portuguese have denominated this part of the ocean the sea of sea-weeds. Naturalists are as yet ignorant of the manner in which these floating sea-weeds are detached from the bottom of the ocean, and of the reason why they are confined to particular regions. In the economy of nature they seem to be useful in affording food and shelter to fishes and molluscous animals, and they probably tend to maintain the purity of the ocean.

Fucus vesiculosus.

From several species of sea-weeds, more especially the *Fucus vesiculosus*, *nodosus*, and *serratus*, as well as the *Chorda filum*, and several species of *Laminaria*, a valuable article of commerce is obtained, denominated *kelp*. This substance, which consists chiefly of an impure carbonate of soda, is procured by burning sea-weeds, and is employed in the manufacture of glass and soap. The practice of collecting the ashes of the sea-weeds was introduced into Scotland in the year 1722. It had been carried on some time previous to that in France and England. The Orkneys was the first part of Scotland where kelp was manufactured, and though the innovation was resisted at first by many of the inhabitants of these islands, it soon became a profitable article of export, and has contributed not a little to enrich the proprietors. It has also long been manufactured in great quantities in the western islands of Scotland, and a large part of the population of these islands have been chiefly supported by this means. Lately, Spanish barilla, which is an alkaline substance, proceeds from the ashes of the Salsola Kali and other maritime plants, has been found superior to kelp in the formation of glass and soap, and from the removal of the duty on salt or muriate of soda, the impure alkali can be procured at such a cheap rate by chemical means, that the demand for kelp is much diminished. In consequence of this, many poor people have been deprived of their usual employment, and have been compelled to have recourse to other means of subsistence. The value too of many of the estates in the Hebrides has fallen much on this account.

Many of the sea-weeds are used as articles of diet. The *Rhodumenia palmata* furnishes the dulse of the Scotch, the dillesk of the Irish, and the saccharina sea-weed of Iceland. Pepper-dulse and tangle, sold as articles of food in some parts of Scotland, are also kinds of sea-weeds. From the various species of Porphyra and Ulva a substance is procured, which, when pickled or stewed, is brought to table under the name of *Laver.* The edible nests constructed in Asia by a species of swallow, the *Hirundo esculenta,* are composed of several species of *Gelidiciun,* a sea-weed common in the maritime parts of that country. The *Alaria esculenta,* called in Scotland badderlocks, or honey-ware, is also eaten. The *Fucus vesiculosus,* sea-ware or sea-wrack of the English, kelp ware or black tangle of the Scotch, serves for winter food to cattle in several districts of Scotland. The cattle are said to devour it greedily, and to repair regularly to the shores at certain seasons of the year for the purpose of procuring this and other species of sea-weed. The *Chondrus crispus,* a sea-weed known under the name of carageen or Irish-moss, has been employed in Ireland and other parts of this country as an article of diet. It forms a kind of blanc-mange, which is very palatable and nutritive. A year or two ago it was used for a short time in an institution in Edinburgh as a light article of diet for invalids.

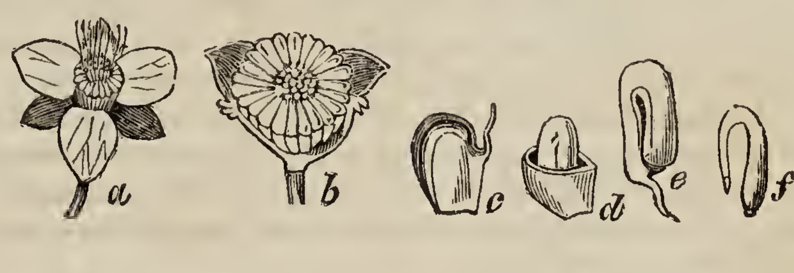
In a medicinal point of view, sea-weeds are by no means destitute of importance. *Gigartina helminthocaton,* or Corsican moss, a sea-weed found in the Mediterranean, was formerly much used as a vermifuge. The *Fucus vesiculosus* was introduced formerly into the British Pharmacopœias, and was used with success to discuss scrofulous swellings. By burning it in close vessels a kind of charcoal was procured, called vegetable æthiops, which was also exhibited medicinally. Not many years ago it was discovered that this and the other species of sea-weeds contained a peculiar substance, which has received the name of iodine. It was found that nearly all the medicinal properties of the sea-weeds were owing to the presence of this substance, which is now extensively prepared from sea-water, and used in place of the sea-weeds themselves, in cases of goitre and scrofulous tumours. It is a curious fact, that several species of Laminaria have been long eaten by the inhabitants of South America as a cure for these diseases; and burnt sponge, which is now known to contain iodine, was formerly in use for similar purposes.

Sea-weeds are also employed for a great many other purposes. The *Gracillaria tenax* is used as a glue and varnish by the Chinese; and the *Laminaria buccinalis,* on account of its hollow stem, is used at the Cape of Good Hope for making trumpets.

The appearance of *red snow,* so often mentioned by Arctic voyagers, is ascribed to a species of sea-weed called *Protococcus nivalis.*

Sea-weeds are extensively used as manure, and for this purpose are gathered in various maritime districts. The Highland Society have also lately made experiments in regard to the value of kelp as a manure, and their success has been such as to induce extensive landholders to purchase considerable quantities for agricultural purposes alone. Next to the algæ which yield the *kelp* above alluded to, the saltwoods (salsola) on our shores are manufactured for the same purposes. This is a genus of plants which, after due preparation and calcination, produce the alkaline salts called barilla, soda, potash, and kelp. These plants, like maritime algæ, require sea air as well as water to bring them to perfection. Most of them are herbaceous and annual, but some have shrubby stems. *Salsola kali* is found on the sandy shores of most parts of the world, and is generally burned for soda for the glass manufacture. *Salsola soda* is cultivated in Languedoc and also in Spain for making barilla; but is reckoned inferior to *Salsola sativa* which grows on the Spanish shores of the Mediterranean, and affords the best soda consumed in Europe. It is called by us Spanish or Alicant soda. In September the crop is cut and laid in small heaps to dry. These heaps are then collected and burned, forty or fifty of them in a hole in the ground. Soda is in common use in the manufacture of glass and soap; with sulphur, it forms Epsom salts; with marine acid, common salt; with the salt of Homberg, borax; and with cream of tartar, Rochelle salt.

ALISMACEÆ. The hundred and eightieth order of the Jussieuan system, containing three genera; viz. *sagittaria, actinocarpus,* and *alisma,* of which there are twenty-six species. The flowers are white, the divisions of the calyx and petals are distinct, and have many seed-vessels. They form a beautiful tribe of hardy aquatic perennial herbs, natives of Europe and America.



ALISMA PLANTAGO. *a,* flower of the natural size; *b,* fruit; *c,* a single capsule; *d,* the same in section to show the seed; *e,* seed (magnified;) *f,* the embryo (do.)

Of the genus *Sagittaria* there are six known species; one of which, the common sagittifolia, is the handsomest of our indigenous water plants. Several of the other species are natives of China, Japan, and North America. In China some of the species are cultivated extensively, the root forming an important article of food. The roots, however, are much larger in those countries than they are with us; of the *Actinocarpus,* there are two species, one a native of England, and the other of New South Wales, both pretty floating aquatics

ALLAMANDA (Linnæus). A splendid flowering tropical tree, native of Guiana. Linnæan class and order, *Pentandria Monogynia.* Natural order, *Apocyneæ.* Generic character: calyx, five parted; corolla, funnel-shaped, but in five regular divisions; five subsessile arrow-shaped anthers; ovarium superior, surrounded by a disk; style one, stigmas adhering to the anthers; fruit round, compressed, covered with membranous spines, filled with many seeds. There is only one species described.

ALLANITE (prismatic cerium ore). This mineral was first accurately described by Dr. Thomson, in the Edinburgh Philosophical Transactions. It is massive in its character, and of a brownish-black colour. Its specific gravity is about 3·6, and it occurs crystallised in four, six, or eight-sided prisms. It may be proper to add, that the ores of cerium analysed by Berzelius, under the name of cerin, approach very closely to it in their composition.

ALLIGATORS. A genus of aquatic Saurian reptiles of large size, formidable structure, and voracious habits. There is not much difference between the crocodiles of the eastern world and the alligators of the western, neither is there much difference in the signification of the two names. The crocodile was named by the Greeks after a yellow lizard, the exact species is not known, from the feet of which there exuded a liquor of a musky scent; and the alligator is only a corruption of the Portuguese words for lizard, and was by them applied to the crocodiles of western Africa before the American species had been discovered.

Alligators are, as one would say, ungainly, and even ugly animals; but they are not naturally ferocious; they kill only to eat, and they kill but one at a time. If indeed the prey is so tough that they cannot break it by the pressure of their jaws, they take it under water, and bury it there till it becomes softened by partial putrefaction. In these cases, the same unquenched hunger sends them to look for more; and they continue the process till they can meet with something which can be eaten instanter. No reptiles masticate or grind their food; and few, if any, give it a second bite. Their jaws close like the sides of a spring trap; and if they do not enclose the whole of the prey, the only way that the animal has of detaching the portion which they do seize, in order to swallow it, is by shaking it; and when they are unable to accomplish this, they bury it under water in the manner which has been stated.

Animals, when swallowed whole or nearly so, take of course longer in digesting than when they are torn or chewed; and thus the alligators are, like the larger swallowing serpents, dull and languid for some time after a full meal.

At all times, indeed, they are indolent animals; for though they can walk tolerably fast, and swim faster, the greater part of their time is spent in inaction, and some of it, in the colder climates, in a torpid or dormant state.

In climates where they hybernate, they dig for themselves hybernating dens with the entrance under the water, but the chamber so high as that the water does not reach it. It does not appear that any animal which breathes free air by means of lungs, has been known to hybernate under water. There is some doubt, in the case of the frogs of cold countries; but the analogy is against it, and there is no direct proof to rebut the analogy. Upon the confines, however, the lungs of some of the aquatic reptiles, and the gill cells of some of the cartilaginous fishes, have so near a resemblance to each other, that the line of distinction, though there is no doubt of its existence, is a nice point to determine. It is worthy of remark, too, that the reptiles and the fishes alluded to are both tenacious of life in proportion to the sluggish action of their system; and there is also something curious in the growth of their bones.

During the heat of the day, the alligators either lie stretched and languid on the banks, or in the mud, on the shores of the rivers and lagunes, which are the favourite haunts of the animals; and as the other natives of such localities (the winged ones which sport in the sun excepted) are generally at rest at these times, the consequence is, that, during the day, they capture but few animals, excepting such as wander near them. They sometimes, however, are put into motion and noise in the heat and drought, by that singular wave called the "bore," which is known in some of the fen rivers of England, and which is often very high and violent in its motion in the level-bedded rivers of warmer climates. Heavy and strong as the full-grown alligators are, the force of the bore rolls them powerless before it; and they rattle against each other, and bellow, adding much to the noise and confusion. There is no bore in the bays or lagunes, and none in rivers above the first rapid, even though that is an inconsiderable one; and thus, during the hot and sunny days, the alligators in these are at peace. When evening comes, however, they begin to move, and the roaring of the larger ones is terrific. It is a compound of the sounds of the bull and the bittern, but far louder than either; and it grates and shivers on the ear as if the ground were shaking. Whether it produces any effect upon the prey of the alligators, in making that prey disclose itself by its efforts to escape, is not known; and, indeed, harsh and terrific as it is, it seems not only to be the common noise of the reptiles, but also their love song, which they emit frequently and freely in the pairing season. The history of the pairing is not very complete; but there are some reasons for concluding that they are polygamous. The males engage in fierce though uncouth battles at that season, and not, as has been observed, at any other; and the fair inference is that these are battles of gallantry. They usually take place in the water, though in the shallows rather than the depths; and, at first at least, they are bouts of cudgel-play, rather than battles with the teeth. When it comes to the latter, it is desperate, and the death of one, sometimes of both, is inevitable. It has already been said, that the alligator can give no second bite; and as little is it disposed to leave the first one, till the object which it seizes is fairly under water. The jaws close in the same manner as those of the "biting turtles," and they can with difficulty be wrenched asunder, even by a lever of considerable length.

As is the case with all the larger reptiles which find their food chiefly in the water, the alligators are oviparous, and the females deposit their eggs in holes of the banks, above the water mark, which they excavate with their paws and snout, and cover again after the eggs are deposited. Though the animal is sometimes very large, fifteen, twenty, or even thirty feet in length, and in the latter case little less than two feet in diameter where thickest, the eggs are not larger than those of a goose, and indeed generally not so large. They are eatable, as also is the flesh of the animals; but the flavour of both is rather musky for European palates. As to the number of eggs which the female drops, authors are not agreed; some say as many as a hundred, and others little more than a fourth part of that number. Both are, probably, in so far right; for as the female returns to the water every day, it is probable that she deposits part only in one hole. During that operation they are not voracious; and perhaps they, like the turtle, abstain in great part from eating at that time. Their grand feasts are during the floods, especially the first of them, whether from the southern rains, or the melting of the snows at the sources of more northerly rivers, such as the Mississippi. These rains by their violence beat down many animals, and sweep away many animal remains, wafting them all to those temporary lakes in the forests, in which the water stagnates with its floatage. Recent or putrid mammalia, birds, reptiles, or fish (for some of the latter are killed, and many lose their management), are all the same to the alligators. Mountain cat, monkey, vulture, parrot, snake, lizard, fish (the gymnotus itself), or even the deadly bushmaster, all find jaws ready to seize them; and while the harvest lasts, which may be about eight or ten weeks in the average of places, the reptiles wax fat, and are able to undergo the labours of the year with little food, as has been said.

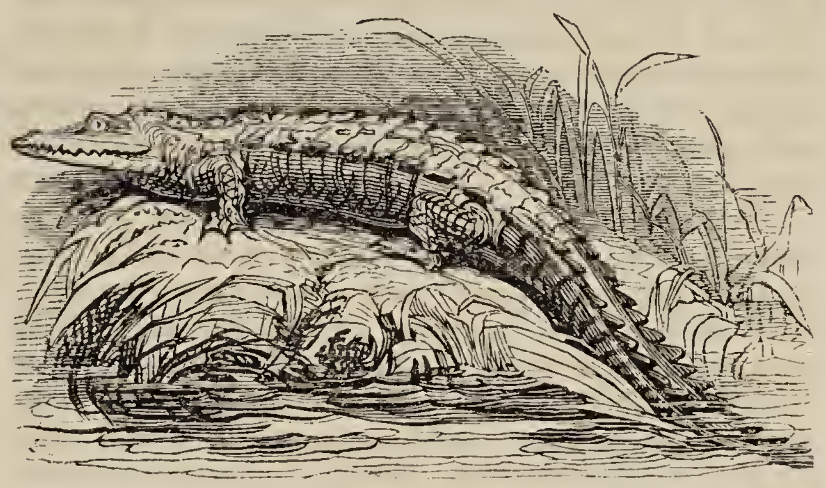
And there is not a doubt that these large and powerful reptiles, whether alligators, as so called, crocodiles, or gavials, perform an important part in nature's economy by so doing. In spite of all that they take, and they are neither few nor indolent at that time (for in them as in other creatures the time of activity and of appetite is the same), there remains enough to putrify and steam up with the returning heat, so as to render the atmosphere abundantly pestilent to all who have the hardihood to encounter it. But if they did not do their work, and if the larger grallidæ and the vultures did not come after as soon as there is provision for them, the banks of the rivers could not be approached within many miles, unless by those who sought to die there.

We mention those scenes and circumstances, not for the sake of those whose taste in natural science goes after "an alligator stuffed;" but who would rather know something of the haunts of the alligator, and of what that very powerful and very peculiar animal does there. And it is for a similar reason, rather than for any urgent systematic necessity there is for it, that we have resolved to divide the family, or perhaps, systematically speaking, the genus, into the three popular sections of alligators, crocodiles, and gavials. By this means we shall be able to render each group an index to a certain portion of the work, equally interesting and peculiar in all its characters.

The most remarkable distinguishing character of each of these groups is the shape of the head. The gavials have it the most produced, the crocodiles the next, and the alligators have it shortest. In them the length of the jaws from the articulation is only one half more than the greatest breadth. The teeth have a ragged appearance, as some of them are long and others short. There are never fewer than nineteen in each side of either jaw, and sometimes two more in each side of the under one. These grow with the growth of the animal; and receiving cavities are formed for them in the upper jaw, especially from those fourth from the front, which are longer than any of the others. The body is low and squat; the hind legs are nearly round in their section, and have no membrane on the sides; the webs of the toes also extend only half the length; and the holes behind the orbits, which are understood to secrete a musky fluid in the crocodiles, are small and obscure, or wanting.

From the structure of the feet, and the want of fringed or pectinated membranes on the hind legs, which are both a lessening of the pelagic structure, alligators keep more to the fresh waters, the rivers and lagunes, than the crocodiles; so that those in the bays of the West India islands, though popularly known as alligators or *caymans*, are rather to be considered as crocodiles, even in the popular sense of that term.

The following figure will afford a better general notion of the shape of the animal than could be given in even a lengthened description.



There are four species or more, all natives of the warmer parts of the American continent; but varying in their appearance, so as in some of the species to resemble the crocodiles, and in others the gavials.

The species which, in the written accounts at least, is the most ferocious and formidable to man is that which inhabits the Mississippi and the other rivers of the southern parts of North America, and the swamps and lagunes which these rivers form when they are swollen by floods. It is the pike-headed aligator (*Alligator lucius*) of Cuvier, so called because its head, in shape at least, bears some resemblance to that of the common pike. This species has been seen as long as fifteen feet; with the head two feet long, and the gape nearly the same. The jaws are more clongated than in some other species, the breadth at the articulation not being in those of the size mentioned much more than one foot. The snout is flattened on the upper surface, and slightly turned up at the extremity, which is bluntly pointed; but the sides of the jaws are, for the greater portion of the length of the gape, nearly parallel. The teeth are large and irregular, with the fourth from the front in each side of the under jaw much larger than the rest, so that they can penetrate through a substance of considerable thickness, and, with their points received into the sockets in the upper jaw, hold on against a very considerable strain. It is by this means that the animal is said to master the larger mammalia, when they come to the shores to quench their thirst. The alligator, having observed its prey, swims slowly toward it, with the snout barely above the water. When within reach it seizes the upper lip and nose; and at the same time incurvating its body with more than ordinary exertion, hits a violent blow on the shoulder with its thick and scaly tail. The bite and the blow together bring the animal to its knees, tumble it headlong and helpless; and as the alligator does not quit its hold while the animal continues to struggle, and also contrives to keep the head under water, the prey soon expires of pain and suffocation. The smaller mammalia are generally foundered by the blow of the tail, and then seized by the head and drawn under water till they are suffocated. But in what state soever prey of this description is eaten, whether recent or after it has been partially decomposed by time, it is always eaten on land. They do not feed under water, any more than they breathe in that situation; but while in the water, they often contrive to feed in the air. They do so both upon birds and fishes. The low-flying ones of the former, they sometimes catch as they skim the surface on the wing; and they get under the swimmers, jerk them clear of the water with the snout, and instantly seize and swallow them. When it preys on fishes, it gets below them and endeavours to jerk them out of the water in a similar manner, in which case it swallows them at once; but if it seize them under water, it rises to the surface, tosses them into the air, and again seizes and swallows them as they fall. The latter manœuvre has been stated by travellers, and the statement has been repeated by compilers, to be performed in order that the alligator may expel from its mouth the water which it has taken in while seizing the fish. This however, an absurdity. The fish in the water is taken crosswise; and consequently the reptile, by merely rising to the surface, could easily retain it and expel the water. But the fish, especially if it be of considerable length, is held in such a way as that it cannot easily be swallowed. It is therefore tossed into the air; and following the general law of animals in that state (for the exception of cats is doubtful), it comes down head foremost; and thus is either killed at once by the bite, or swallowed with ease. Many of the mammalia deal with their small prey after a similar manner. The dog, for instance, seizes a rat across the body; the vital parts are too far within the gape for the canines; the rat bites; the dog gives a whine, tosses it up in the air, seizes it by the head as it falls, and the rat bites no more.

This species of alligator is most numerous in the fresh waters immediately to the northward of the Gulf of Mexico, and it is abundant in proportion as the locality is marshy, full of putrifying things and pestilent. The vast tide of the Mississippi shows, upon the grandest scale any where to be met with, the power of running water over the earth. Trees, forests, islands, are moved about by it, as lightly as dry stubble by the autumnal floods of our rivers; and therefore excepting in the cold season when they remain torpid in their hybernacula under the banks, it is always harvest time with the alligators, and also with the soft turtle (*Testudo ferox*), which is as voracious in proportion to the turtles of other places, as the pike-headed alligator to the other alligators. Many of the accounts of these reptiles as given by authors must be received with deductions; but after every allowance, they are bold and formidable enemies.

The species most frequently met with in the rivers of Guiana, is different in appearance, and not so daring in its manner. It has the head shorter and broader; the teeth smaller, and a bony protuberance over each eye; on which account Cuvier terms it *A. palpebrasus*, the eyebrowed alligator. It rarely if ever attacks any animal on land, though in the season of activity it is abundantly active in the water. It was upon the back of one of this species that Mr. Waterton performed that ride which he describes with such graphic naiveté, in his "Wanderings in South America." The feat seems a desperate one; but, after all, what could even an alligator (or *caiman* as it is there called) do, with the barbs of a hook, the size of an ordinary faggot, lacerating its stomach, by the joint action of a dozen men pulling it to the beach, and its own resistance in endeavouring to keep the water?

There are other species which inhabit the rivers further to the southward, which have the muzzle more produced; and the accounts state that they are milder in their manners in proportion as their habitats are more southerly. Enough has already been said on the general characters; and the specific varieties in form, whether of the animals themselves or of the plates with which their skins are variously armed, are of small value in a popular point of view, as they have been connected with no peculiarities in the habits of the animals. See Crocodile and Gavial.

ALLIONIA (Linnæus). A genus containing two species of ornamental annuals, natives of Cumana. Linnæan class and order, *Tetrandria Tetragynia*. Natural order, *Nyctagineæ*. Generic character: calyx, four irregular coloured divisions; stamina, four; style, one; fruit, an akenium formed by the hardened and persisting base of the calyx.

ALLIUM (Linnæus). Garlic. This is a most numerous family of bulbous-stemmed plants, there being no less than 117 species, and many varieties. Linnæan class and order, *Hexandria monogynia*. Natural order, *Asphodeleæ*. These plants are known from all others by their peculiar scent, taste, and usefulness in cookery. Their flowers grow on globular heads; the capsules have three angles, three valves, and three cells, and the round stems of some of them are hollow and curiously inflated in the middle. Many have showy flowers, so as to gain for them a place in the flower garden. But they are most valued in the kitchen garden, where the following are always cultivated:—*A. cepa*, the onion; *A. porrum*, the leek; *A. ascalonicum*, the shalot; *A. sativum*, garlic; *A. ophioscordon*, rocambole; *A. fistulorum*, the Welsh onion; and *A. schœnoprasum;* all of which will be treated of under their English names.

ALLOCHROITE. A mineral body, usually classed with the garnet; it may, however, be distinguished from the common garnet by its lighter colour, as well as its inferior lustre and transparency. Allochroite is usually of a greenish-grey and brown colour. It is found in Norway, where it is associated with calcareous spa, brown garnet, and magnetic ironstone.

ALLSEED. A genus called Polycarpon by botanists, containing two small annual swamp plants, natives of England and Spain. Linnæan class and order, *Triandria Trigynia*. Natural order, *Paronychiaceæ*.

ALLSPICE. A name given to the fruit of the pimento, or clove tree, well known in commerce; and to the flowers of the *Calycanthus florida*, from their similarity of scent to the pimenta.

ALLUMINITE. A mineral of a snow-white colour, which occurs along with selenite in calcareous loam. It is found both in Saxony and Scotland.

Steffens is of opinion that this mineral, and the selenite with which it is accompanied, are formed by the decomposition of iron pyrites; the sulphuric acid thus formed is supposed to unite with the lime and alumina; with the lime it forms sulphate of lime or selenite, and with the alumina an alum, with a superabundance of alumina.

ALLUVIUM. A term employed by geologists to designate those accumulations of sand, earth, gravel, and other materials brought down by the passage of running streams, or deposited by the action of the waves of the ocean.

Water is one of the most active agents in the changes which are continually taking place on the surface of our globe. Its action in the form of rain, and even in the almost invisible vesicles contained in the atmosphere, though slow, is equally certain in its operation with that of the rushing torrents which were let loose when the foundations of the great deep were broken up. Hard rocks are thus gradually disintegrated, and each change of temperature tends to separate a new layer from many stony bodies which bid defiance to all the ordinary processes employed by human ingenuity.

Alluvial soils, generally speaking, occupy the lowest and most level tracts of country; and when viewed in connexion with rivers, point out in the most striking manner the original level of their waters. Thus we find that when the level of a lake, or river, has sunk in consequence of spontaneous or artificial draining, the alluvial soil which has been deposited will mark a higher line of level than its surface.

The alluvial formations constitute the great mass of the earth's surface. They may be divided into two species; namely, those deposited in the valleys of mountainous districts, and those deposited upon flat lands.

The first species consists of sand, gravel, &c., which constituted the more solid parts of the neighbouring mountains, and which remained when the least solid parts were washed away. They sometimes contain ores (especially gold and tin) and the alluvial soil is washed, in order to separate these ores. On mountain plains there are beds of loam. The second species of alluvial deposits, or that which occupies the flat land, consists of loam, clay, sand, turf, and various fossil remains. Bituminous wood and iron ore also occur. The sand contains various species of metals.

To render our account of this subject more intelligible, in a geological point of view, it may be advisable to notice, somewhat in detail, the Huttonian opinion of the origin of alluvial deposits, in connexion with the formation of our globe.

Dr. Hutton does not go back to chaos to lay the foundation of his habitable world; nor does he borrow much assistance in constructing his fabric from chemical attractions. He rests upon a pre-existing continent, out of the ruins of which our present dry land was formed and arranged principally by mechanical means. The portion of the globe which we now possess, was, according to his hypothesis, the bottom of the sea, and the previous continents having sunk into the depths of the ocean, new land rose to supply their place, which thus became the present terra firma; and, lest we should be alarmed at the recurrence of a similar catastrophe, we are told that it will be followed by a slow but similar renovation. Thus, as one continent descends another rises, like the opposite scales of a balance; and, in the resources of the system, that order of organic nature is supposed to be traced by which the continued existence of the different races is secured, not by the perpetuity of the individual, but by the successive reproduction of the kind. Our present world is thus one in an indefinite series of worlds which have existed in times past, and which are destined in future to appear; and all the less obvious or more striking changes which we witness are but steps in the progress of mighty revolutions, to which the imagination could set no limits, either with regard to duration or magnitude.

Dr. Hutton lays down as a certain position, that the solid parts of our earth are suffering decay from the action of the elements; that the portions detached from the more elevated ground are carried by the operation of water to the lower levels. Thus forming the alluvial masses of our globe. He conceives, that those portions which reach the ocean are acted upon by tides and currents, which arrange what is carried within their influence in layers along the bottom of the sea. Thus every river, every brook, every stream of water that we see, descends towards the ocean, charged with some portions of the surface over which it flows. All the soil and softer parts on which our plants are produced, have been confessedly loosened by water, and may be ultimately transported by it to the lowest levels of the same element. The strata of our dry land have all been thus carried from a pre-existing one, and arranged by the ocean, which then covered it. It may, however, be proper to remark, that effects have been attributed to the action of running streams, much beyond what their mechanical operation would at all seem to warrant. We have seen that Dr. Hutton supposes that the materials of all the strata are the debris of a former world; that they have been detached from it by the operation of the elements; carried, by the agency of water, to the ocean; and there spread in regular order over its bottom by the same power. It is true that most rivers flow towards the ocean, charged with a part of the soil or softer rock which border their channels; but it is not so true that they carry all this burden to their ultimate destination. A great part of it is deposited on their banks, or in the hollows of their courses; and much of what reaches the sea goes to form bars, or, being driven back to the shore, makes an addition to the sea-coast. It is evident that a small portion only can reach the ocean; and if, as Dr. Hutton himself observes, the description which Polybius has given of the Pontus Euxinus, with the two opposite shores of the Bosphorus, the Mæotis, the Propontis, and the port of Byzantium, is as applicable to the present state of things as it was at the writing of that history; if the isthmus of Corinth is apparently the same at present as it was 2,000 or 3,000 years ago; if Scylla and Charybdis remain now, as they were in ancient times, rocks hazardous for coasting vessels; if the port of Syracuse, and the fountain of Arethusa, the water of which the ancients divided from the sea with a wall, do not seem to be altered; and if, on the coast of Egypt, we find the rock on which was formerly built the famous tower of Pharos; and, at the eastern extremity of the port Eunoste, the sea-bath cut in the solid rock on the shore, to all appearance the same at this day as they were in ancient times; if such be the extreme slowness of the disintegration, the reflection is obvious, that, admitting it, a duration will be allowed to the world infinitely beyond our conception, and adequate to any purpose which we can conceive it designed to serve.

We may now, however, proceed from the mightier phenomena which occupy the attention of the geologist, and which have tended to produce such extraordinary changes on the surface of our globe, to the lesser though no less certain effects resulting from the action of rivers in comparatively modern times.

The wearing and transporting powers of a running stream depend upon the volume of water, and the quantity and size of the solid matter suspended, and the velocity with which it moves. A river generally runs with the greatest rapidity in the higher parts of its course, where, indeed, it often consists of a succession of torrents and cataracts for many miles, but it has not yet acquired its full destructive force, because the mass of water is still comparatively small, nor has it yet become loaded with solid matter. In the lower part of its course, long before it joins the sea, it has usually reached a level country, and there its velocity becomes greatly retarded. The Senegal in Africa does not, according to Adanson, fall more than two feet and a half from Podor to the sea, a distance of sixty leagues. But the increase of the volume of water in rivers during the flood seasons is often prodigious. The bed of the Mississippi, at Natchez, about 300 miles above New Orleans, measuring along the course of the river, scarcely exceeds a mile in breadth when the water is low, whereas in the flood season the mass of waters is nearly thirty miles wide. The Orinoco, at St. Thomas's, two hundred miles from its embouchure, is about three miles and a half wide in the dry season ; but when flooded, its waters, according to Dupens, stretch out to the enormous breadth of seventy miles.

Here we find a beautiful provision for fertilising the surface of the earth, which is well worth our examination. Fresh deposits are thus added to the alluvial formation, which are of the greatest value in the processes of vegetation.

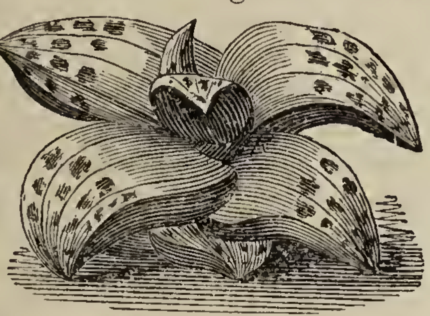
How truly may it be said that where the Nile is there is Egypt, and where the Nile is not there does that in some respects fertile land cease to exist for the benefit of man. The inundation of this river, and the formation of its alluvial deposits, are phenomena which have attracted the greatest attention at every period of scientific inquiry. The ancients, who witnessed no instance of inundation in any other river, exhausted themselves in conjectures as to the cause ; and each found it more easy to overthrow his neighbour's hypothesis, than to establish his own. Even Pococke ascribes it merely to the effect of the Etesian winds blowing from the north at a certain season. The cause is now perfectly ascertained in the periodical rains which fall from June to September, throughout the northern tropical regions. From these the Nile is exclusively fed, as it scarcely receives a single stream in its course, north of the tropic. The rise begins to be felt about the 17th of June, and continues till August, when the river is at its height, and all the level parts of the country are overflowed. On the level plain of the Delta, inundation takes place spontaneously, and at an early period. When the waters have retired, the soil of Egypt is covered with a slime more or less thick. Its colour is at first black, but in drying it changes into a yellowish brown. It then cracks, and exhibits fissures, showing that the slime was deposited in horizontal layers. This slime is about one-half composed of alumine, and contains also a large proportion of carbonate of magnesia. The principles of vegetation are thus copiously contained in it, so that it not only stands itself in no need of manure, but supplies its place to other lands. On the banks of the river it contains a great quantity of sand, which diminishes in proportion as it is carried to a distance from them. Hence clay is produced in all the various states which the arts require.

Water, when in rapid motion, produces alluvial deposits, differing very materially in their character from those we have now been describing. The force of a river, when directed against any obstacle in its course, is very considerable, even by its own weight alone, especially if it be flowing over a highly-inclined surface ; but its destructive power is greatly augmented if it be loaded with sand and gravel. In floods, very considerable blocks are carried by the stream to great distances ; for it must be remembered that these are much more easily moved in water than on land. If the water flows with a velocity of three inches per second, its force, when free from suspended matter, is sufficient to tear up fine clay ; six inches per second, fine sand ; twelve inches per second, fine gravel ; and three feet per second will tear up beds of loose stones of the size of an egg. The flood occasioned by the bursting of the barrier of a lake in the valley of Bagnes, near Martigny, in the Vallois, moved at first with the tremendous velocity of thirty-three feet per second, it was afterwards diminished to eighteen and eleven, and at the end of its course, when the water reached the Lake of Geneva, it was still running at the rate of six feet per second. From the barrier to this point, the fall is 4187 Paris feet, the distance is forty-five miles, and the mass of water passed over this space in five hours and a half. It swept along houses, bridges, and trees ; masses of rock, equal in dimensions to houses, which it tore out of an ancient alluvial soil, were carried a quarter of a mile down the valley. A flood that happened in the north of Scotland, in 1829, afforded numerous examples of the power of running water to transport large blocks of stone. On the river Nairn, a fragment of sandstone rock, fourteen feet long by three wide, and one foot thick, was carried above two hundred yards down the river. The river Don forced a mass of four or five hundred tons of stones, many of them two or three hundred pounds weight, up an inclined plane, rising six feet in a few yards, and left them in a rectangular heap, about three feet deep, on a flat ground. If then such large masses can be moved by the action of water, even by the ordinary and every-day operations of nature, we may easily understand how, in the gradual progress of ages, the whole amount of alluvial soil which we now find may have been brought into its present situation.

Under the article GEOLOGY will be given a general view of the connection which alluvial soils bear to the various stratified masses which form our globe, when it will be shown how admirably they are proportioned to the wants and comforts of man, as well as to the subordinate parts of the animal kingdom.

ALMOND. The well known fruit of the *Amygdalus communis*. There are six species ; two of them are dwarf ornamental shrubs, the rest are small trees, bearing fruit of different qualities, that from the *communis* and its varieties being most esteemed. The shores of both sides of the Mediterranean Sea are the native habitat of these fruit trees, and whence great quantities are annually exported to all the northern parts of the world. In this country almonds rarely ripen their kernels; the trees being planted for the beauty of their flowers only. They are easily propagated by budding on their own or on plum stocks.

ALOE. This is a numerous family of succulent plants, mostly of a half-shrubby description. A few are herbaceous, and all treated as inmates of the greenhouse. Linnæan class and order, *Hexandria Monogynia.* Natural order, *Hemerocallideæ.* Generic character: calyx, monosepalous, tubular, almost cylindric, in six divisions; stamina, six, inserted into the base of the calyx; stigma, three-lobed; capsule, three sided, of three places, containing seeds. The south of Africa is the habitat of the aloe family; and there some of the species grow to the height of fifteen or twenty feet, though by far the greater number are of more humble growth. The leaves are thick, rising out of the embrace of each other; variegated in colour, smooth, or warty, and many are defended by spines as well on the disk as on the edges and points of the leaves. The flowers are not terminal, but rise from among the leaves laterally, and appear on long spikes either erect or drooping. The well-known drug bitter aloes is drawn from some of the species. Soccotrine aloes were esteemed the best; but the spicata fig is in every respect equal. The drug is obtained by draining the juice from the dissevered leaves. *A. soccotrina* is cultivated in the West India islands for the manufacture of the drug.



The aloe family was formerly much more numerous than it is now; many of the species have been removed to form new genera, as *Pachidendron* and *Haworthia;* and several have been removed to old genera. They are altogether a remarkable family of plants; their thick fleshy leaves being in the shape of tongues, cushions. spears, &c.

ALONSOA (Ruiz, Pavon). A small family of exotic undershrubs, containing four species, requiring greenhouse treatment. Linnæan class and order, *Didynamia Angiosperma.* Natural order, *Solaneæ.* Generic character: calyx, monosepalous, persistent, five-cleft; corolla, monopetalous, irregular, lips turned back, divided, upper divisions short, reflected, the two lateral thrice the size of the upper, the lower largest; stamina, didynamous, declining; style, longer than the stamens; stigma, bifid; capsule, oval. This genus is closely allied to *Hemimeris.*

ALOSA—Shad. A genus of abdominal soft-finned fishes, belonging to the *Clupeadæ,* or herring family. The shad genus has been very properly separated from the herring and the pilchard, with which it was classed by Linnæus; as they are different from these in appearance and in habit. The herring and pilchard are migratory fishes; but they migrate in the sea only, and never ascend the rivers above the mean line of separation between the entirely salt water and the entirely fresh, and seldom indeed so far. Shads, on the other hand, ascend the larger rivers into the fresh waters; and they appear to spawn there in preference, whereas the herrings spawn on the shores of the sea. The herrings, too, come later, or perhaps, with reference to the time of spawning, it is more correct to say earlier. They come in winter or even in autumn, and the shads not till April or May The herring fry, or herring "sail," as the countless myriads of the young of these fishes are called, appear, indeed, to form much of the food of the shad as it ascends the estuaries; and the shad is a ravenous fish-eater, which is not understood to be the case with the herring. In its migration it may be said to be intermediate between the herring and the salmon, both in the time and the height to which it ascends the rivers; and, as is the case with the salmon, it lingers for a considerable time in the brackish water, before ascending into the fresh.

The reason why they linger there is an important point both in the natural history and the economic use of this fish. It is a well-known fact in chemistry, that when two liquids of different densities unite together, there is a want of *compenetration,* by which a certain degree of heat is produced, as much as three or four degrees of the common thermometer in the case of sea and river water, supposing that they have both the same temperature previously. At the mouth of a river there is a constant union of this sort; and though the maximum increase of heat moves a little with the tide, it does not move nearly so far as that does, for the wave of tide flows up the fresh water, and ebbs out a considerable way into the salt. By this means the fishes, when, in their migrations, they resort to the estuaries for the sake of the heat, are not moved like tidal things, but rest in a limited space; while the water passes and repasses over them, and procures them plenty of food, both in its ebb and its flow.

While the salmon, the shad, or any other fish having this migratory habit, remains in the salt water, it does not appear to be capable of breeding, or of bringing forward the roe and milt, so as that they shall be fit for depositing. The same appears also to be the case if the fish remain in the fresh water; and, besides, they lose flesh in the fresh water. The descent to the sea is thus necessary to restore them to vigour as individual fishes, and the resort to the brackish water is essential to their fertilisation. When they are first met with in the offing of the estuary they are in fine condition as food, and the roes are small. As they linger in the brackish water the roe increases rapidly, and the quality of the fish falls off, though not so rapidly in proportion. When the roe has attained nearly its full size, the fishes ascend into the fresh water, gradually falling off in quality, so that those caught in the upland streams and in the brackish water do not appear the same species. The difference is most conspicuous in the salmon, but it is very evident also in the shad; and even in the herrings, which do not resort to the brackish water, the first that come are always the best.

The species of shad best known, and indeed the only one, is the common shad (*clupea alosa* of Linnæus), the distinguishing character of which is a cleft in the snout; there is also an irregular black spot behind the gill cover, and the mucous ducts on that organ are finely branched. In the warmer parts of Europe (for the shad inhabits more southerly than the herring or the salmon) it attains the length of three feet; but in our estuaries it rarely exceeds half that length. In Scotland, where it is taken in the salmon nets, though not in any considerable quantity, it is called the "elf-herring," that is, the plague or pest of the herrings; and the name is not an undescriptive one, as the large herrings disappear before the shad comes, and it eats great numbers of the young ones, which are often found entire in its stomach. In some parts of England it is called the "mother of herrings," which, unless we are to suppose that "mother" is a corruption of "mouther," or swallower, is by no means appropriate. It follows the general law, being excellent in flavour when it first appears in the estuaries; but dry, tasteless, and unwholesome, as it descends to the sea.

The *white bait* of the Thames, which is so renowned among the metropolitan epicures, used, till within these few years, to be considered, by writers on British fishes at least, as the young of the shad. The contrary has, however, been very clearly demonstrated by Mr. Yarrell, whose researches have tended much to the advancement of natural science generally, and which have thrown the clearest light upon some of the erewhile darkest points in the economy of our native fishes. The white bait has enough of the distinguishing characters, both of appearance and interest, to entitle it to be made a species, if not a genus. It has more of the herring character than the shad has; and Cuvier very properly ranked it next to the sprat, though it is more delicate and less seaward than that fish. In the whole breeding time it inhabits almost the mean line of the brackish water, seldom, if ever, reaching the perfectly fresh, and being seldom met with at that season when it is understood to be pelagic. See WHITE BAIT.

All the fishes which resort to the shores, estuaries, and rivers, for the purpose of depositing their spawn, are highly valuable in an economical point of view. Taken at the proper place and season they are finer food than any other fishes; they are taken with less hazard; and in one or another of the species they are in season during the greater part of the year. Some general account of their habits, qualities, and mode of being captured, will be found in their order, from the most pelagic, to the most fluviatal, in the article MIGRATORY FISHES.

ALPHÆUS. A genus of crustacea, belonging to the order *Decapoda* of Cuvier. The habits of these animals are very quiet; a habit so well known, that if they remain long in one spot, they become the prey of numerous marine animals of various species, more particularly shoals of fish. The best known and most remarkable species is the *Alphœus avarus*, which has been described by Fabricius. This author first established the genus from four species brought from the Indian Ocean; but many specimens have since been discovered in the European seas, particularly in the neighbourhood of Nice, in the Mediterranean, where Rizzo found four other species, which he has described.

The *Alphœus caramote*, described by Rondelet, was found on a muddy bank in the midst of rocks. It had the four anterior feet terminated by a didactyle claw, the carpus of the second articulated; feelers lateral, situated underneath the middle, having the peduncle covered by a shell annexed to the base; the shell prolonged forward in the form of a beak; the feelers at the middle always being smaller than they are laterally. They are distinguished from all other crustaceæ by their two pair of feelers, and by the manner in which their four anterior feelers terminate.

ALPINIA (Willdenow). A genus of hot-house perennial herbs, mostly natives of the East and West Indies; comprising twenty-four species, and belonging to the first class and order, viz. *Monandria monogynia* of the sexual system, and to the monocotyledonous order *Scitamineœ.* Generic character: calyx, tubular, three-toothed; corolla, double, the outer three-parted and converging, the inner of one lip, and having a tooth at each side of the base; stamens have linear filaments, not extended above the anthers, which are not crowned; style, thread-shaped, rising above the anthers; stigma, concave; seedvessel, a berry. These plants require stove treatment, a rich soil, and a high moist temperature.

ALSODEA (Thouars). A genus of two species of stove undershrubs, natives of Madagascar. They belong to *Pentandria Monogynia,* and to the natural order *Violaceœ.* Generic character: calyx of five sepals, somewhat imbricated: petals of the corolla are equal; urceolus, perigynous, five-lobed, bearing stamens; anthers, inserted at the bottom of the lobes; style clubbed; capsule, of three valves, containing eighteen seeds.

ALSOPHYLA (R. Brown). An ornamental green-house fern, introduced from New Holland.

ALSTONIA (R. Brown). A genus of only two known species of tropical undershrubs, natives of India. They belong to the class and order *Pentandria Monogynia,* and to the dicotyledonous order *Apocyneœ.* The generic character is a calyx of five divisions; corolla salver-shaped, limb five-parted, obliquely lacerated; stamens included in a tube; filaments short, anthers free, emitting pollen along their whole length; squamæ not perigynous; style simple, stigma dilated; folliculi very long, seeds ciliated on both sides.

ALSTRŒMERIA (Willdenow). A family of stove and green-house perennials, indigenous to South America. They belong to the lily class and order, viz. *Hexandria Monogynia,* and to the natural order *Amaryllideœ.* Generic character: calyx, resembling a corolla, somewhat bell-shaped, six-parted, two-lipped, the inner sepal narrow; stamens inserted in the base of the calyx, declining; anthers oblong, erect; style also declining; stigma three-parted; capsule somewhat round, six-ribbed, three-celled, and three-valved; seeds roundish. This is a highly ornamental family of plants, and deserves a place in every collection. The elegant position, and beautiful markings of one of the most common species, *A. pelegrina,* has made it a universal favourite. *A. ligtu* is highly fragrant; and as they have all tuberous roots, those of *A. edulis,* are used like potatoes in the West Indies. Some of them are so hardy as to bear the open air, if planted under and trained to a south wall. There is one peculiarity in the position of the leaves of this genus which distinguishes it from all others, viz. the twisted form of the petioles or footstalks of the leaves, by which the inferior disk is turned to the sky, and doing the office of the superior. There are ten species already described; and it is reported by travellers that there are several others in South America not yet introduced.

ALTERNANTHERA (R. Brown). A genus of green-house and stove herbaceous plants, natives of South America. They belong to the fifth class and first order of the sexual system, and to the natural order of the *Amaranthaceœ.* Their generic character is having a calyx of five sepals; stamens alternately fertile and barren (hence the generic name); style short, stigma headed; the utriculus one-seeded. There are ten species; but none of them bear conspicuous flowers.

ALUM. A mineral salt, much employed in the useful arts. The minerals that afford alum either contain it ready formed, or they contain its constituent parts, which are disposed to unite and form alum, when placed under favourable circumstances. This latter is the most frequent case. It is found in each of the great divisions of our globe, and occurs as an efflorescence, or in delicate curved and parallel fibrous concretions; also crystallised in octahedrons and cubes.

Alum mines are said to have been first found in Italy, in 1460; and in the sixteenth century the process of alum-making was commenced in Germany and Spain, and a little before its conclusion works were established at Whitby, in England, by sir Thomas Chaloner. King James I., by advice of his ministry, assumed the monopoly of it himself, and therefore prohibited the importation of foreign alum; and in 1625 the importation of it was further prohibited by a proclamation of Charles I.

Alum is manufactured near Glasgow, from slaty clay, which is obtained from old coal pits; the slate contains also iron pyrites, and both its constituents combining with oxygen, sulphate of iron is formed, with excess of sulphuric acid, which acting upon and combining with the clay or alumina of the slate, forms a double sulphate or ferro-sulphate of alumina, which crystallises in small filaments of a greenish white colour. When the slate containing this double salt is put into water, it is dissolved; by evaporation, crystals of sulphate of iron are obtained; and to the solution, which is principally sulphate of alumina, potash is added, and crystals of salt are formed; these are purified by re-dissolving them in water and crystallisation. By exposing to air and moisture the slate which remains after the solution of the sulphate of iron and alumina, a further portion of the pyrites is acted upon, and more sulphate of iron and alumina are obtained, which are dissolved, as before, in water.

ALUTERES. A genus of fishes belonging to Cuvier's order of *Plectognathes*, (plaited lipped fishes) and the family *Sclerodermes*, or hard-skinned. They have the body long, slender, and compressed; the muzzle produced, pointed, and ending in a small mouth, with about eight teeth in each jaw. Their first dorsal fin has only one ray, which gives it the worm-like appearance on which the generic name is founded There are several species noticed by authors; but very little is known of the habits of any of them They are pelagic fishes, with large air bladders; and like the file-fish (*balistes*) which they resemble in their more general characters; they are understood to be pernicious—at all events, they are not eaten.

ALVEOLITES. A genus of zoophytes, the major part of the species of which are known only in the fossil state. They are closely allied to the corallines. Four species are enumerated, three of which have as yet been found only in the fossil state. They are to be met with in the environs of Dusseldorf and Dax. They very rarely occur in this country. Specimens referred by Parkinson to two of the species, the incrustans and suborbicularis, are described by him; the one as imbedded in flint, the other in a mass of Portland oolite.

AMARANTHACEÆ. A natural order of dicotyledonous plants, the characteristics of which are: stamens situated below the ovarium, or seed vessels, sometimes abortive; anthers, one or two-celled; calyx, three or four-leaved, persistent, occasionally with bracteæ at the base; fruit in a membranous bladder; seeds, lentiform, pendulous, having a hard brittle shell; leaves, simple, opposite or alternate, without stipulæ; flowers, scabrous, in heads or spikes, usually coloured, generally hermaphrodite, pubescent, simple, the hairs divided by partitions.

AMARANTHUS PANICULATUS. *a*, barren flower, bearing stamens only; *b*, fertile flower, bearing pistils only; *c*, stamen; *d*, fruit bursting its envelope; *e*, vertical section of the seed (magnified); *f*, the embryo ditto.

In the young plants of this order the leaves are of a soft, lax texture; the seeds farinaceous, consisting chiefly of starch and mucus; their virtues are nutritive; and some of them, particularly the root of *Gomphrena officinalis*, are tonic and stimulant. The amaranth, from which the order derives its name, are herbaceous plants, generally annuals, the flowers of which form in bundles at the top of the stalk. The species are very numerous, and are very generally dispersed over both hemispheres, increasing as the distance from the equator increases. Some of the plants belonging to the order are beautiful ornaments in the flower-garden, and much cultivated for the graceful and pendulous masses of their flowers.

AMARYLLIDEÆ. An order of *Monocotyledoneæ*, and the hundred-and-ninetieth order of the natural system. It comprises thirty genera, and four hundred and sixty-four species, of which last there are as many varieties. Some of the most splendid of these will be found in the accompanying plate, of which the following is a description:—

Crinum giganteum.—Few plants surpass this in the majestic beauty of its flowers. It is known to gardeners by the name of the Cape Coast Lily, and was brought, about fifty years since, from the south-western coast of Africa, of which it is a native, and where it is highly prized by the natives; being worn as a charm to preserve them in war, and guard them from pestilence.

Amaryllis formosissima.—This flower, as its trivial name indicates, is the fairest of its tribe. It is propagated by offsets, which may be taken off every year; the best time to shift and part these roots is in August, that they may take good root before winter. They should be planted in pots of a middling size, filled with light kitchen garden earth; and if they are kept in a moderate degree of warmth, they will produce their flowers in plenty from March to the beginning of September.

Amaryllis belladonna.—Is generally considered to be a native of the Brazils. It is now, however, common over the whole of the European continent, particularly in Spain and Italy. Seedsmen receive the bulbs yearly in abundance from Portugal, and these, when planted close to the foot of a southern wall, will blow annually, after they are once settled, which is not till after the lapse of two or three years. We recommend it, for its beauty and fragrance, to all those who love a fair flower in October.

Hæmanthus Coccineus.—There is a deep solemnity about the aspect of this gorgeous flower, which admirably fits it for association with the lighter productions of the green-house. It is a native of the Cape of Good Hope, where it harmonises very finely with the delicate heaths, which in immense multitudes cover its arid plains. Miller first cultivated it in this country in 1731.

They are all herbaceous, bulbous-stemmed plants. The flowers of all are conspicuous; and the ease and safety with which they can be transported from place to place, and from one distant country to another, has led to their more general diffusion from their native habitats than any other order of plants whatever. The constitutional structure of *Amaryllideæ* shows that they are adapted to sandy districts of the earth; and where they would be liable to destruction from drought, were it not from their concentrated body of vitality existing in and protected by the encrassated stem. So that in the burning plains of Africa, the bulbs, whether upon or beneath the surface, remain uninjured, while every green or thin expansion of vegetable tissue is withered up. *Doryanthes* and *crinum* are the Goliaths of the tribe; and though magnificent plants, with their long linear leaves, and ample tresses of flowers, they are far outshone in gaudy beauty by the *Hæmanthus*, the *Amarylli*, and even by the far more common *Narcissi.* Lilies, of whatever size or hue, are attractive. They are often chosen as emblems by the poet. Many are harbingers of returning spring: even the most lowly of the tribe, the humble snow-drop, meets a kindly welcome.

AMARYLLIS. This is a splendid family of bulbous plants, chiefly natives of the more southern parts of Africa and America. They are hexandrious polypetalous flowers, and from their strongly-marked character have given a name to the extensive order described above in the system of Jussieu, viz. *Amaryllideæ.* The generic character is, a spatha generally containing several flowers; germen on a long footstalk, clubbed; perianthium in six parts, somewhat gaping; throat sealy (rarely membranous), crowned, or naked; limb spreading; stamens inserted in the tube, and declining; anthers leaning; capsule three-lobed, three-celled, each many-seeded; the seeds flat, with winged margins.

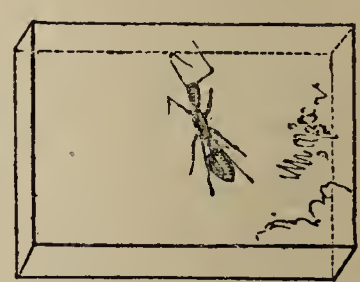
There are above a hundred species and varieties of this fine family, which are supposed to be the "lilies of the field" mentioned in sacred writ. Throughout the winter and spring months they are among the most resplendent ornaments of the greenhouse and conservatory. One circumstance makes them particularly valuable to the florist, viz. the facility with which they hybridise with each other by manual impregnation, by which their various forms and colours are admirably blended: thus giving at once an endless variety, and a source of amusement to the cultivator, and profit to the commercial florist. The amaryllis may be raised from seeds or from offsets. They require (particularly the stove species) a pretty rich loamy soil, and should be kept in large pots to flower them in perfection. The greenhouse species also like rich soil; and after they have done flowering should be kept quite dry, either in the pots, or laid for a month or two on a shelf in a dry airy place. Here they will often present the point of their flowers while yet on the shelf; which is a sure sign that they require repotting. The *blanda, belladonna, reginæ, vittata,* with its numerous varieties, and the *formosissima,* are among the finest flowerers. The flower of the last mentioned is a bright crimson, or deep scarlet, and continues a good while in bloom.

AMATHIA (Lamouroux). Celluliferous polypidoms. It is a branching polypidom; the cells long and cylindrical, united in one or many groups. The amathias, by their numerous cells, their horny and hollow stem, filled in a living state with a gelatinous and irritable substance, exhibit the general character of the order; they differ, however, from their neighbouring genera, by their aspect, their ramifications, and also the form and respective situations of their cells. In some species these are united in isolated groups, resembling Pan's pipes, with reeds varying in length; in others all the groups touch, but can easily be distinguished by the unequal length of their cells; some of them have their polypous cavities united at the sides, forming spiral and projecting lines round the stems, to which they adhere by their base; and there are some in which these lines cease to project forward, and are attached to the stem by the back part of the cells; therefore, notwithstanding the apparent difference between the *A. lendegira* and the *A. spiralis,* it is impossible to place them in separate genera, on account of the intermediate species which imperceptibly link together beings at first sight exceedingly dissimilar.

The amathias are of a horny substance, very slightly chalky; their colour is a fawn brown, more or less deep; they vary in height from one-eighth of an inch to six inches. They are frequently found parasites on the *Thalassiophytes*; sometimes they adhere to rocks or other hard substances by a fibrous base, and they appear more common in the equatorial and temperate seas, than in the cold or icy regions of either pole. Six species are described.

AMBER. A resinous body, called electrum by the Greeks. Some naturalists refer its origin to the vegetable, others to the mineral, and some even to the animal kingdom. It is described by Pliny as a resinous juice, oozing from aged pines and firs, and discharged thence into the sea. He adds, that it was on this account that the ancients gave it the name of succinum.

One of the most singular peculiarities of some amber is the existence of insects of various kinds enclosed beneath its surface. An instance of this occurs in the accompanying figures, copied from a specimen in the British Museum.



Many of the yellow transparent masses containing insects, and sold under the name of amber, are in reality only concretions of the common copal; and in the cabinet from whence the above specimens were taken, the right-hand figure is marked *copal* and the other *amber*, although there are no external marks which would enable an observer to distinguish the one from the other.

Germany affords great quantities of amber, obtained from the beds of lignite, as well as thrown on the shores of its seas and rivers. Saxony, Misnia, and Sweden, and numerous other places in this part of Europe, abound with it; and it is found on the shores of the Baltic in large quantities. Prussia and Pomerania afford it in abundance. The former country was celebrated for its amber, as early as the time of Theodoric the Goth, who, we are told, imported it from thence. On account of its beautiful colour, great transparency, and the fine polish it receives, amber is even now considered as an ornamental stone, and is cut into necklaces, bracelets, snuff-boxes, and other articles of dress. Previous, however, to the discovery of the diamond, and the other precious stones of India, it was the most highly prized of jewels, and was employed in all kinds of ornamental attire. Great quantities of it are annually exported from Dantzig to Constantinople, the Levant, Persia, and France. The most considerable purchasers of amber are the merchants of America and Greece; but it is still uncertain how they dispose of it. Amber forms an important article of exchange in Africa; and when dissolved, it is the principal ingredient in a species of varnish, named amber varnish.

AMBER TREE. Is the *Anthospermum Æthiopicum* of Willdenow; a diœceous plant from the Cape of Good Hope. It bears some resemblance to a heath, and the leaves are highly fragrant when bruised: hence its English name.

AMBASSIS. A genus of spinous finned fishes, of very small size, and inhabiting the fresh waters of tropical countries. The gill-lid is pointed, and there are two spines on the gill-flap and one upon the first ray of the anterior dorsal fin. They bear some slight resemblance to the perches, to which natural family they are referred. Some of them are quite transparent; and they are caught in numbers in some of the warmer countries, and prepared like anchovies.

AMBROSIA (Willdenow). A genus of eight species of sweet-smelling annuals, natives of North America and the south of Europe. They belong to the natural order *Compositæ*, and hold a low rank on the scale of vegetation; their scent being the only property for which they are regarded.

AMBLYGONITE. A pale green mineral, marked superficially with reddish and dark yellow spots. It is found massive, and crystallised, in oblique four-sided prisms; is of a vitreous lustre, fracturing uneven, and the fragments rhomboidal.

AMEIVA. A genus or sub-genus of American Saurian reptiles, belonging to the lizard family, but differing from the true lizards, and also from the monitors. They inhabit the banks of rivers and streams in the forests of tropical America, depositing their eggs in the sand, and occasionally taking to the water, in which they can both swim and dive with much ease. Their tails are round, their heads tryrancidal, they have no scaly plates over the eyes; the scales on the neck and throat are small, and those on the posterior part of the body rather larger. The species are numerous, but not well defined. Indeed, the natural history of reptiles, in all its departments, is very imperfect, there being many unnamed specimens in most collections, and the habits of few, indeed, being accurately known.

AMELANCHIER (Lindley). A name given to a kind of medlar, with which it used to be associated. The genus consists of three species of deciduous shrubs, and one evergreen. Like the medlar, they are icosandrious, and in the natural order *Rosaceæ*. The genus is distinguished from mespilus by its ten-celled ovary. As shrubs they are used in ornamental planting, but only for the sake of variety.

AMELLUS—Asters. A family of three species of North American perennial herbs. They belong to *Compositæ*, but of no striking character. This name is given by Virgil to a beautiful flower growing on the banks of some river, but which has never been truly identified by botanists; the general opinion runs that Virgil's plant is no other than the *Aster amellus*, a common plant in every flower garden.

AMENTACEÆ. Is the hundred-and-forty-second order of the Jussieuan system. The order is well defined, and embraces the greater number of our most useful forest trees. The principal mark of distinction is the unisexual flowers; that is, the males are placed in aments or catkins, quite separated from the females. The catkins of the hazel, or common nut tree, give a very good idea of this mode of florescence. For though the catkins differ in size, colour, and form, according to the kind of tree, yet their agency is the same in all. The development of the males usually precedes that of the females, and on some trees is very conspicuous, as on the willows and poplars, which appear to receive a kind of clothing from the countless numbers of male catkins borne by them. In this order we find the following genera: viz. willow, poplar, alder, birch, hornbeam, hop-hornbeam, hazel, oak, beech, Spanish chestnut, plane, Comptonia, candleberry, myrtle, and casuarina; all of which are described under their English names. See PLATE.

AMERICA, or the Western Continent. One of the grand divisions of the habitable globe; and one which, whether we regard any one of the kingdoms of nature singly, all the three in their connexion, or the whole in their succession, opens a field of great and peculiar interest to the student of nature. From the comparatively recent period at which this vast portion of the world was added to the knowledge of the rest, it is frequently styled "the *New* World;" and in its natural history it is as new as in its geography. Not that it is in any respect a more recent formation, because on it the traces of remote antiquity are as visible as on any other part of the earth; and though, of the parts of it which are now under culture, the greater portion has been won from a state of wild nature, in times so recent as that the whole progress is matter of easily obtained history, yet we can no more assign a date to the first action of those causes which brought America into the state in which it was first known to European discovery, than we can assign a date to the turning of great part of central Africa into a desert, or to the drying up o those waters which, according to the traces which remain, and which are too marked and decided for leaving any doubt, once covered a great portion of central Asia.

The grand point of difference, and the one which gives America its principal charm in the estimation of the naturalist is, that we can have a clear view of the whole continent as it came from the hand of nature, or, which is the same in effect, as it is moulded and fashioned by natural causes only. The cultivation which was carried on by the Mexicans, the Peruvians, and some other people, among the mountains of the west, was, according to the accounts of the parties themselves, (and nations have never shown any disposition to abridge their annals,) of comparatively recent introduction, and limited extent. Human industry had not there, as in many parts of all the divisions of the eastern continent, contended with the flood, the forest, or the desert; but each of them had been allowed to assume its dominion to the full extent of its powers. As little had cultivation clothed the fields with artificial plants, or stocked them with trained animals, the native localities of which, and their habits in a state of nature, had been forgotten and lost, during successive ages of cultivation and change. It is true that the few nations on the American continent among whom traces of civilisation were found were migrant races, for it appears that in no case can there be improvement without migration; but, unlike the migrants of the old continent, they appear to have migrated without carrying along with them the means of their subsistence, and to have trusted to the day for the day's supply, in the same manner as is done by the savage. They drove no flocks or herds, they carried no seed corn. When they settled, indeed, they did make a little provision against the season of want, but that provision was all obtained from the natural produce of the country in which they resided; so that, when the Mexican empire was in the zenith of its power, it could not be said that it had added even one new plant to the soil, or one new animal to the pasture.

Up to the time of its colonisation by Europeans, America may, therefore, be regarded as a country moulded wholly by the operation of natural causes; and throughout the greater part of its vast range in latitude it must, from the extent of sea which lies between it and the other continents, have been moulded by causes operating within itself. The natural history of America is, therefore, in a great measure, a subject complete in itself, between which and the several parts of the eastern continent there are not the same relations as these parts have to each other. No doubt it is subject to the same grand laws of the year, on which climate and seasons depend; and the plants and the animals must be in accordance with these. But there are peculiarities in the form, the position, and the surface of America, which modify its climate, and through that, all its growing and living productions; and we must take at least some knowledge of these particulars along with us in order rationally to understand even the elements of its natural history.

The position of America upon the map is in itself worthy of attention. There is no country which lies so far upon a meridian, or has its central elevation so much in the meridional direction. What with land, what with ice, it may be said to reach the pole at the north, and thence it extends unbroken to the latitude of about 56° south; so that in round numbers it may be said to oppose to the currents of the sea and the atmosphere a barrier of ten thousand miles in length, or, taking the flexure of the mountains which bend much westward in the northern part of the country, of not much less than twelve thousand. That barrier, too, is not only complete against the sea, but against all those lower strata of the atmosphere which can be supposed to have much effect upon plants or animals; for, with few interruptions of any kind, and hardly any save where the isthmus is narrowest, is there any interruption that can be supposed to admit of an interchange of climate; for though there are some passes in the isthmus, these are overlapped by the projecting high land in Venezuela, so that any wind from the east, blowing so far to the northward as to clear Cape Gallinas, would be taken by the table land of Mexico, and turned by the eastern side of the Stony Mountains down the great central valley of North America. To the northward of the Gulf of Mexico, the mountains near the shore of the Atlantic confine the influence of that ocean to the line of the coast, to which the valley of the St. Lawrence barely forms an exception, as the influence of the great lakes at the upper end counteracts that of the sea at the lower, and the entrance of the latter between the high grounds below Quebec is a mere pass, and that pass interrupted by Newfoundland and the other islands. South of the Gulf of Mexico, the wind from the tropical Atlantic sweeps along the valleys of the Orinoco and the Amazon; but these are both, at their terminations, cut off by the lofty cordilleras of the Andes. South of the Amazon the different mountain ridges in the eastern part of Brazil again interrupt the communication between the interior of the country and the sea; and even in the flat country to the southward of La Plata, though the current of sea air sweeps a considerable way over the Pampas, the Chilian Andes form so effectual a barrier to it that it never reaches the western shore.

Thus, the slope from the great summit eastward, which comprises by much the greater part of the whole surface of the continent, is divided into a number of valleys or basins, having their atmospheric motions in the direction of their own lengths; sometimes between the mountains and the sea in nearly a direct line, as in the case of the valley of the Amazon; sometimes oblique, as in the St. Lawrence; and sometimes directly across, as in the central valley of the Mississippi.

On the western side, the mountains are, generally speaking, so near the sea as only to leave a mere margin, or at best but a narrow plain, unless in some places towards the north, where the connexion between the sides of the continent is interrupted by the cross current of the central valley.

In general, the current, both of the ocean and the atmosphere (in so far as the latter of these depends on the former), sets across the Atlantic from the east, sometimes a little south of the equator, and sometimes a little north; but upon the average of the year only a degree or two north of the equator itself. The greater portion of both currents is turned by the northern heights on the left bank of the Amazon, and circulates round the Gulf of Mexico, the aërial part of it ascending the valley of the Mississippi, when the regions to the north have been dried by the action of the summer; and the aquatic part circulating round the Atlantic, in the gulf stream and its continuations. In summer, when the current is at its greatest distance northward, and also at its greatest strength, because of the less interrupted run which it has at that season, the weather up to very high latitudes in the central part is warm, so as to ripen in Canada, fruits which can hardly be brought to maturity in the milder climates of Europe; and were it not for the evaporation produced by the vast surface of lakes in that part of America, and also by the forests with which many parts of the country are shaded, there is no doubt that the surface there would soon assume a more sterile and dreary character than is to be met with even in the bleaker parts of Siberia.

The countries which open to the sea further southward receive an abundance of humidity, though they receive it seasonably only; and in them, though peculiar in its character, vegetation is proportionally luxuriant.

On the west coast there is in general much less action between the mountains and the sea, as the general current both of the air and the waters there sweeps along the line of the coast, alternating with the seasons, and occasioning great disturbances of the atmosphere at its changes—violent storms of thunder and lightning, heavy falls of rain, and winds of hurricane violence.

The general motion of the oceanic waters is thus a current playing round the American shores, northward on the eastern shore to the north of the Equator, and southward along that to the south; and then by Cape Horn around the whole line of the west. The great return current is by the north of the Atlantic, and that current casts the wreck of America—the timber brought down by the spring freshes, and the more constant currents of such rivers as the Mississippi, which continually shift their beds in the soft alluvial soil—upon the islands that lie along the shores of the polar ice, and partially, it may be, upon some of those of Siberia. That wreck consists chiefly of timber, and the quantity of it is so great, that it affords an abundant supply to Iceland and some other places which have no timber of their own. The supply has been afforded from time immemorial; and there are places where immense floats of it are now covered with soil, and others where it has partially been converted into coal by the action of volcanic fire.

America is too remote from Africa for allowing the passage of any animal, even of a bird, from the one to the other, as birds do not migrate much in longitude, especially within the torrid zone, in which these continents make their nearest approximation. With Europe, also, there is no direct communication, even by means of the polar ice; and the communication with Asia is limited to the extreme north-east of that quarter of the world; thus the only part of Asia which has an ice-connexion with America, and in so far resembles it, is by the eastern mountains, and the intervening deserts, in a great measure cut off from the rest of Asia, so that the north-west of America can hardly be said to have an Asiatic character.

The natural productions of America are just what, from the peculiarities of its situation, we should be led to expect. Generally speaking they are very different from those of the other parts of the world; and the situations which they are found most to resemble are those in which there is the clearest connexion.

The mineral productions do not properly come within the scope of these distinctions, because, with the exception of some of the salts found in the soil, we know but little of the effects of difference of climate in the formation of minerals. The mountains of the American continent are, however, peculiarly rich in metals. The gold, the silver, and the copper of the Andes have been all long known and much esteemed; and the mountains of the north are particularly rich in iron. The gold is usually found native or metallic, and in a comparatively pure state; but it is mixed with much soil, from which it is separated by washing, the great specific gravity of the gold causing it to remain at the bottom of the vessels. The places, where that operation is performed, are by the Spaniards and their descendants called *lavaderos*, that is, washing stations; and the search for gold is in general accounted a work of great labour, and very uncertain profit. Silver is found in much greater quantity, and the operation of mining for it, though still one of some hazard and much expense, is one of more certainty to those who can command the requisite capital. In Peru, where it is perhaps more abundant than in any other part of the country, though some of the Mexican mines have been far richer in pure or native silver, it is found high in the mountains, but generally at no great depth below the surface, and sometimes it is disclosed by the mere removal of the vegetable sod. In the richest mines, the silver is generally mixed with brown oxide of iron, and the stratum in which this mineral is contained is often limestone. But notwithstanding the importance of the American mountains, especially those of central and South America, in an economical point of view, the geology is still in a very imperfect state, and so must remain till many additional discoveries have been made.

The mineral kingdom is not, as has been said, under the influence of local or climatal circumstances; and the effect which minerals, at least those at even a moderate depth below the surface, have on the vegetable and animal productions is not very great, or at least not very satisfactorily made out. So that, with these considerations, we must take the living productions as they occur, without seeking to establish any general connexion between them and the minerals which they help to conceal.

The vegetables of America resemble those of the eastern continent much more at the northern extremity of the country than in any other part; but what may be considered as the polar vegetation ranges much farther to the south than it does in the old continent, especially in Europe. The north-west of America and the north-east of Asia, which approach each other in geographical position, also resemble each other in climate and productions much more than the north-east of America and the north-west of Europe. What connexion, if any, there may be between the maximum of cold in the northern parts of America, and the situation of the magnetic pole, has not yet become matter of philosophy, though it does appear that there is some connexion between them. But, independently of that circumstance, there are, in the northern parts of America, sufficient natural causes to induce a very intense degree of cold. There is no current of tidal water by the sea from any warmer region; all the winds that blow come over either cold, and for the greater part of the year, snowy heights, or they come over lakes and swamps which are calculated to produce intense cold by their evaporation. There is thus no means by which heat can come from any other region, and, for a great part of the year, the heat of the sun is much absorbed in the melting of snow and ice; so that, in the extreme north, the average temperature is below that of freezing; and though the difference in latitude is two or three degrees, Melville Island is more dreary and barren of vegetation than Spitzbergen. The plants are very few, and of the most humble growth. Even in our progress southward, especially toward the eastern part of the continent, a latitude answering to the average of that of the British islands must be arrived at before we come to a climate equal on the average to that of Lapland. The trees are not quite the same species; but we find in the country about the southern parts of Hudson's Bay, and on the northern frontiers of Canada, spruces (the black and the white) bearing some resemblance to the same coniferæ on the Lapland mountains; and we find them accompanied by the same under-growth of reindeer moss and other lichens, which, if not precisely the same, are so much alike that they impart similar characters to the countries.

Nor is it in the forest alone that we have this correspondence of vegetation, with considerable difference of latitude, for the swamp and the marsh present nearly the same characters. Cranberries and other hardy plants cover the surface, and give a polar character to the marshy flats south, even to the very margin of the great lakes, or to a latitude answering to that of the finest vine countries in France. When this polar character begins to give place to something more promising, the vegetation gradually changes; and although the trees and plants are often of the same genera with those of the eastern continent, they are generally of different species,—of species, for the most part though not always, more rapid in their growth, more remarkable for the variety of their tints when they fade in the autumn; and, generally speaking, much more spongy and less durable in their timber.

In these respects there seems to be a sort of correspondence between the timber and the soil on which it is produced. There are not in the northern parts of America any of those specimens of a firm green sod composed of soft, kindly, and matted grasses which are so well known, and so much and justly admired in this country. The few grasses which do appear are dry and wiry, or they are hard, and belong only to the marsh or the margin of the pool. The dry land is raw and bare—a pool at one season of the year, and blowing with black powdery dust at another, or if there is any intermediate state, it is that of a land covered with different species of *compositæ*, which, when the land is cleared, often multiply in such numbers that they not only become pests to the farmer, but absolutely choke and keep down all other vegetation; and that too upon land which, but for them, would be among the best in that part of the continent.

When Upper Canada is arrived at, there we find the very extremes of temperature in the course of the year—a polar winter and a tropical summer. In the former, the whole land, or at all events the water in it, is consolidated like iron, and in the latter, the melon, the tobacco plant, the rice plant, in situations which suit it, and probably also many of the other natives of hot climates, can be cultivated with success. But the extremes of heat and cold are severe tests of the soil; and when the primeval forests are cleared off, it is doubtful whether the evil may not be increased by the want of trees, even of those species which, at the time of its first settlement, are accounted the pests of the country.

When the summit level of the great lakes is passed, the vegetation of the country assumes a new character; and though many species of pines still occur on those soils which are favourable for them, and the American cedars muster thickly on the swamps, and the rhododendrons, azelias, kalmias, and other plants, which we consider as the ornaments of our shrubberies, abound upon the peaty slopes and hillocks; yet the more compact soils by the side of the streams are overshadowed with deciduous trees of great dimensions and the most graceful foliage.

As the Gulf of Mexico is approached, the elements of vegetable action become in a wonderful degree energetic. The Mississippi and its tributaries roll toward the Mexican Gulf, probably the largest volume of running water which is to be met with any where upon the face of the earth, not excepting the Amazon itself. Estimating from the remotest source of the Missouri in the Stony Mountains, the length of those giant streams is not less than four thousand miles; and much of the valley through which the main branch flows is humid. Besides, what with rains, what with the melting of snows, and what with the rapid descent of the western waters into the valley, there is a great deal of flooding; and the flooding is not confined to the Mississippi, but belongs in part to many of the other rivers in the southern states of the American union. In summer there is not much direct rain in these parts, as the wind is comparatively steady toward the dry grounds, increasing in temperature and capacity for moisture as it proceeds. Accordingly, while the marshes and swamps are reeking with pestilence, in a heat which is all but intolerable, the cultivation of vegetables, even those of a tropical character, goes on with great rapidity and success; and the crops of tobacco in Virginia and Maryland, of rice in Carolina, and of cotton in Georgia, or of all these and others alternated, are most abundant, and carried on with much success and at great profit, though if the cultivation were wholly managed by Europeans, it would be at no small sacrifice of health and life.

As the country is traversed in longitude the character of its vegetation changes very materially, even in the corresponding latitudes. On the Atlantic side the action is between that ocean and the land, and the Gulf-stream rolls northward along the American shore a volume of water from the tropical regions, which, even in comparatively high latitudes, is several degrees warmer than the still waters and eddies of the same places; that of course carries with it a current of air equally warm in proportion; and thus then is borne to the northward as far as about Nova Scotia, where the current of the stream turns, before it lingers and deposits its load on the great banks of Newfoundland; a climate warmer than that which would otherwise belong to the country. But that climate barely passes within the average line of the Appalachian ridge which runs parallel to the coast; and the centre of the country is within the range of that climate which plays along the valley between the Gulf of Mexico and the north, along the current of a vast flood of water which is continually descending toward the former. On the right bank, too, though the mountains are not bold in their outlines, or apparently gigantic in their altitudes, they rise, by one dull and bleak ridge over another, to a considerable height, and upon them vegetation is but scanty, and trees are comparatively few. The surface there is consequently much under the influence of the season, heated in summer and proportionally cooled in winter, so that even the lower parts abound more in savannahs or prairies, or even in dry and barren plains, than on the opposite bank of the Mississippi. As the latitude diminishes the character improves; but through the greater part of Louisiana, and into the country of Texas, adjoining the northern part of Mexico, much of the surface is of the character which has been described. Near the courses of the rivers, where there is much depth of alluvial soil, and abundance of humidity, the trees grow to large sizes, and many of them are remarkable for their beauty. One of the finest is the deciduous cypress (*Taxodium disticha*), which attains an enormous size, and is equally remarkable for the graceful form and the delicate tint of its foliage. The tulip tree, the black walnut and many others, are also highly ornamental; and all the deciduous ones pass through such variety of tints before they finally drop their leaves, that the autumnal decay of an American forest is almost as gay in its hues as the blossom of the spring is with us.

When the summits of the Stony Mountains are passed in progress towards the shore of the Pacific, the character of the climate again changes, and along with it the vegetation. The Stony Mountains are not one ridge, but a series of ridges, or a succession of clusters of heights, of considerable breadth on the average of their course, and dividing into two branches as they approach the extreme north. One of these branches reaches the shore of the Arctic Ocean to the left of the embouchure of Mackenzie's River, and the other points to the west, terminating continentally in the peninsula of Alaska; but continuing submerged to some distance farther, and having its summits rising above the surface in the islands which lie off that point.

These mountains form a complete barrier between the country on the shore of the Pacific, and that toward the Arctic Ocean and the central valley; and as the set of the current is upon this shore also, generally from the warm latitudes, and Alaska turns any eddy that there might be out to sea, the climate is warmer than in the corresponding latitudes of the centre. The unequal form of the surface, and the vicinity of the sea, cause it also to be more humid; and these circumstances alter the character, and increase the activity of the vegetation. The herbaceous plants are there remarkable alike for the stateliness of their forms, and the beauty of their colours; the shrubs, even the berry-bearing ones, have a gaiety in their blooms, which renders them highly ornamental as shrubbery plants; and some of the forest trees are the very giants of the vegetable kingdom. Some of the pines, or rather perhaps spruces (they are in fact intermediate between the two), would serve singly for the spire of a cathedral; and of the cones of others, the seeds are so large, and contain so much farinaceous matter, that the people roast and eat them as a substitute for bread. It appears that though the plants are, generally speaking, of different form and character, there is some sort of analogy between, at least some parts of the west coast of America, between California and Alaska, and the islands of Japan. The climate of Japan is what may be termed a "collected" climate, brought upon many winds and currents of the Pacific, and tempered by its own varied, and in many places elevated, surface. That climate is substantially temperate; and yet there is a tropical air in the vegetation which it produces. But notwithstanding the tropical beauty of many of the plants, they stand the climate of Europe better than many of the native ones, so that the aucuba, and no doubt also the beautiful camellia, by a little management, might grow luxuriantly in the cottage gardens of all the warmer parts of Britain. The same appears to be the case with the plants of the west coast of North America,—all of them that have been tried, annual or perennial, herbaceous or shrubby, or trees, have grown freely, and multiplied readily; and there is no doubt that, ere many years have elapsed, the majestic pines of those western lands will raise their gigantic pyramids high over the ordinary trees of our forests; and as their timber is said to be good and durable, as well as rapid in growth, there is reason to hope that they will contribute as much to domestic use as to scenic beauty.

In Mexico, though the deciduous cypress still continues on some of the elevated grounds, and the pines wave their green tops over Orizaba and others of the mountain peaks, giving shade and beauty, and supplying timber, the vegetation begins to assume a tropical character. In the sandy and burning plains toward the Gulf, the banana, the plantain, and various other fruit-bearing trees, and the yam, the arrow root, the cassava plant, and many others which accumulate their substance in bulbs or tubers, together with rice and maize in the stronger and more swampy grounds, afford an abundance of food with comparatively little labour of cultivation. Pine apples of various sorts grow wild in the woods; and not the least characteristic or useful plant is the American aloe (See AGAVE) which sends up its spike of many flowers to the height of more than twenty feet, and which in connected rows forms a hedge which no animal can penetrate. It serves the people of the country as a substitute for the vine; as the sugar maple in the northern parts answers as a substitute for the sugar cane. They scoop out the heart of the plant just as it is preparing to send up the flowering stem; and the bottom which is left forms a large cup, in which the substance of the plant accumulates in several gallons of sap from a single individual. That sap is fermented into the common *pulquè*, or drink of the country, which is in very general use all over Mexico; and the pulquè may also be distilled into a spirituous intoxicating liquor, to which the name of *vino mercal* is given.

The country on the coast of the Caribbean Sea to the southward of the Gulf of Mexico, and the westward of Cuba and Jamaica, is remarkable for the closeness of its forests, the violence of its rain-storms at certain times of the year, the quantity of water which stagnates on the low grounds, and the extreme fertility, but, at the same time, the pestilent character of its climate. From that part of America the greatest quantity and largest size of the mahogany of commerce is obtained, though, as it grows in close forests and upon soft and swampy soils, it is inferior to that of Cuba or the other West India islands from which any is still obtained or obtainable. Along with mahogany the same forests yield lignum vitæ, and many woods which, as their colouring matters can be fastened upon stuffs, are of much use in dyeing. On the other side of the central ridge in this part of the country is situated the country of Guatemala, which was once so celebrated both for the quality and the quantity of its indigo.

Passing the isthmus of Panama southward, we come to a country in many respects new in the characters of its vegetation. Here are the same esculent plants as in the hot plains of Mexico; but as the soil is in many places rich, and the surface much diversified, the plants and trees are so numerous, that a mere list of them would occupy a considerable space. The chocolate-tree (*Theobroma*), the nopal (*Cactus opuntia*), upon which the cochineal insects, which yield the finest scarlet dye, are fed; and the various species, the juice of which forms *caoutchouc*, or India rubber, are among the most curious; but the last mentioned substance is the produce of many trees, some of them natives of other parts of the globe.

South America, from the isthmus of Panama to the mouth of the river Amazon, is, taking all the succession of seasons, and all the characters of soil, a compound of almost all sorts of tropical climate that can be imagined. Much of it consists of dense forests, the tops of the trees of which are grazed on by the sloths (see Ai); the branches swarm with birds and American monkeys, all in incessant activity and chatter, the former rivalling in colour the gayest flowers, yet having their flowery rivals in the very same forests, in the magnificent climbing and other parisitical plants which spring up in all places where a root can insinuate itself or a clasper twine, and support a plant which, mouth all over, feeds upon the moisture raised by the heat from those depths of the tropical forest which the light of the sun is unable to penetrate. The lower portions of these forests are often flooded to the depth of fathoms during the rains; and the usual tenants of the wood, the aquatic reptiles, the swimming birds, and the fishes, may be all said to inhabit together in one and the same locality. Places which are bare of trees, and not subject to be flooded by the rains, have generally a very parched character during the dry season; and when the rain comes they change to beds of flowers, or plantations of luxuriant vegetables, as if by magic.

To the south of the Amazon, the vegetable riches of Brazil are even, if possible, more luxuriant than those that have been mentioned. The country stands out more to the sea, and takes the sea-wind, loaded with humidity, upon two of its sides. The soil and surface are, however, both very much varied, and that gives much change of scene to the country. There are not, perhaps, in any part of the world finer bowers and forests than those which are met with in the dells and by the watercourses of Brazil, whether we regard the beauty of the trees, or of the plants which those trees support. The dye-woods of Brazil are of much value, and so are the rose-woods, which are the timber of certain species of *robinia*, the colour and qualities of which are, like those of the mahogany, understood to depend very much on the nature of the soil and situation.

Much of Brazil, and indeed of all the tropical parts of America, where the surface is varied, is, however, covered not by close forests, but by "bush" or stunted shrubs, which are very generally of a hard and prickly character. These, though as tropical in their latitude and more burning in their climate, have none of the perennial verdure and bloom of the tropical forests. They exhibit the tropical clime in a new character, and the year under a new aspect of seasons. During the rains, the bushes put forth leaves, and increase by shoots, in the same manner as our deciduous trees in the summer. But when the drought comes to its full intensity, the leaves disappear, and the bush has the aspect of our hedges and bushes in the winter; not that the plants are burnt up or withered, though the earth to their deepest root may be as dry as the ashes of a hearth. They are fitted to the climate, and they are as conserved and safe as our hardy deciduous shrubs when the ground is frozen around them, and the air far below freezing. Their leaves, when the heat and drought prevent them any longer from performing their living functions, "heal off," and the little buds in their axillæ are as well protected from the drought by their envelopes as our buds are by theirs from the cold. If the rains come twice in the course of the year, at nearly equal intervals, as is the case in some places, these deciduous tropical plants have two seasons of growth in the year.

The plains in these countries are, perhaps, more unlike anything that we are apt to consider a plain, than the woods and thickets are to ours. Their extent is very great, and they are without water, unless when partially flooded during the rains, or when they are crossed by a rough branchless stream, which in the hot season is low between its banks of indurated mud, and diminishes in volume as it crawls along, without perceptibly adding to the life of vegetation even in its immediate neighbourhood. Unless toward the interior, few of those plains in South America are at any time wholly destitute of vegetation; they have generally under shrubs scattered over them which afford some shelter to the herbaceous plants; and there is generally dew during the night, the difference of temperature between which and the day is generally much greater than in temperate climates. Still the vegetation upon them has, in the burning season, much more the character of that of a polar wild after the grass has withered, than of anything to be met with in England. The mammalia on those plains are not grazing animals, but peculiar species of *rodentia*, or gnawing animals, which can subsist upon the sapless vegetation. In some instances, those plains maintain their humidity, and even a perpetual verdure, by means of a double crop, the one part of which affords shelter to the other, till it has covered the ground, and then falls, forming a sort of manure, but sowing its seeds at the same time. One of these crops frequently consists of thistles or other rapidly growing *compositæ*, which begin to sprout as soon as the rain falls, and completely cover the soil, and retain the moisture by the time that it ceases; and under their shade, some more slow-growing herbage comes forward, and again fills the ground, after their leaves have begun to drop, and their stems to become hard.

It is through some such succession as this, changing the species and appearance of the plants with the latitude, that the vegetation of South America passes from the vast forests on the tropical rivers, to the peculiar vegetation of the extreme south. Even there, however, the country has, if not a sort of tropical character, at least a very peculiar one; and one which, though in position upon the globe it is antarctic, is not the same as in any of the other antarctic lands. The araucarias of Brazil, and of Chili, and the southern Andes, are trees unknown any where to the north of the equator; but they are unlike the trees of those southern lands which lie nearest to America, either on the east or on the west. They are not known in Southern Africa, or Van Diemen's Land; and though there are some of the same family in these parts, they have a much lower latitude in New Holland, and are most abundant in some of the smaller isles to the east. Altogether, the vegetation of the American continent is peculiar; and the species become the more peculiarly its own as we advance toward the south. Thus we cannot say that it has derived its plants from any other part of the world, or that any other part of the world has derived plants from it. They are adapted to the climate, and the climate to them; and that is all we are able to say upon the subject.

The animals are still more peculiar; and of those which have not the means of passing by emigration between America and other places, there are few that can be considered as common to it and to the other parts of the world. Our limits will admit of a notice of the vertebrated animals only; and even that must be brief and imperfect. But it is probable that, if they were as well understood, the invertebrated animals would be found to be just as peculiar and as characteristic of the country.

The sea fishes, the cetacea, and the seals, are not, strictly speaking, inhabitants of any country; some of them range over the ocean, and probably circumnavigate the world in all its latitudes and longitudes, and those which are more confined, still range the north seas, from Europe to America on the one hand, and from Asia to America on the other. The pelagic fishes do the same; and so also do many of the bank fishes, and the marine *chelonia*. The cod of the great bank of Newfoundland does not appear to differ specifically from that of the Dogger Bank between Britain and the Continent, at least not more than they differ upon some of our own banks which are not very far apart from each other. The green turtle of the West Indies appears to be exactly the same species as that which is captured on the shores of New Holland; and the hawk's bill or "shell" turtle of the Malay islands in the east appears to differ in nothing from that which is captured in the Bay of Honduras in the west. Many of the migrant birds, which nestle and spend the summer upon the arctic shores of America, are certainly the same species, and in many instances probably the very same individuals, which spend part of the summer with us.

In the fresh water fishes and reptiles more peculiarity may be looked for; and there are certainly many species in the American rivers, to which we have none exactly corresponding in Europe, though to what the difference may be owing it is not so very easy to say. Some of the tortoises of the American rivers are certainly, in so far as is known, peculiar; and probably the same may be said of some of the aquatic sauria. Many of the land sauria are certainly peculiar; and so also are the ophidia—as for instance those two most formidable of poisonous serpents, the rattlesnake of North America, and the bushmaster of South America.

The birds of America, with the exception of the migrant species, are almost all peculiar, and very many of them unknown, or represented by races specifically different, in the other parts of the world. As is the case with the other natural productions, we find the closest resemblance in the north, where we have reason to expect that there may at times be a passage from the one continent to the other. So far as the American species are known, the grouse and partridges of the two continents very much resemble each other, though they are not perhaps exactly the same; and if well made out, the species or varieties in America will probably be found to be the more numerous. The gallinæ are different, there being no American birds at all resembling the common fowl, the peacock, or the pheasant; while, on the other hand, there is no native bird of the old continent answering to the turkey of America. Other than the turkey there is no bird of a strictly gallinaceous character in North America; but in South, where the character of the country is, in certain places and at certain times, better suited to the habits of such birds, we find the *Alectoridæ*. The *Agami*, and some other species, may be considered as in some respects resembling the bustards of the eastern continent, but their structures and habits are not quite the same. The *nandu*, or ostrich of South America, differs from the African ostrich, both in being smaller and in the different structure of the feet. Instead of running upon the loose sand, like its African congener, it runs among the herbage; inhabiting climes which are not quite so warm, and feeding on pastures which are not quite so barren. It has three toes on each foot, all furnished with nails, and it inhabits, from the plains in the interior of Brazil as far south as the extremity of the continent. The most singular races of birds on the American continent are the toucans and humming birds of the southern forests; the last of which are equally remarkable for their diminutive size, the brilliancy of their colours, and their power of wing. It should seem as if they were made to rival the beauty of those flowers among which they are found hovering, and fanning their tiny wings with a rapidity and continuance of motion, which almost takes them out of the class of beings which have their muscular energy clogged by physical weight. They range far and wide over the southern part of the continent, and apparently unaffected by the rigour of the climate. Some of the species are found at the very southern extremity.

The land mammalia have their characters, of course, much more in accordance with those of the land than any other of the classes of vertebrated animals; and it is in their peculiarities that we see most clearly the peculiarities of the American continent. Man, even in the lowest state of civilisation, is adapted, morally as well as physically, to the soil and other circumstances in which he is placed; and on that account, if we include man in our estimate of the adaptation of the mammalia to their country, the argument will be weakened and vitiated to the full extent to which he exercises his mental powers.

In America we find proofs, both that man is so far modified by the physical circumstances in which he is placed, and that he is in other respects proof against those circumstances and can control them. In the extreme north of America we find the Esquimaux nearly the same polar people which are found in the extreme north of the other continent, and who, in all the movements of nations, do not appear ever to have made any progress southward. We look in vain, in even the moderately temperate parts of Europe or Asia, for any colony of the Laplanders or the Samoiedes; and so also we look in vain among even the inhospitable lands of North America for any colony of the Esquimaux. They do come upon the margin of the land in the summer; but in the winter the frozen sea is their wealth, and the ice and snow are their habitation and shelter. Instead of the reindeer, they no doubt yoke dogs to their sledges, because the rein deer cannot subsist upon the surface of the frozen sea, and live upon the flesh and offal of seals and other aquatic animals. But still the races have the same appearance, the same habits, and the same superstitions; and, like all people whose lives are, in our estimation, hardly worth living, their grand excitements, their most intense hopes and fears, are with the dead. This tendency of man to people the northern desolation with creatures of the imagination, the contemplation of which shall so eke out the scanty tale of the occurrences and experience of his life, is at once a curious display of resource in mind, and an unanswerable proof of its existence, independently of all physical circumstances, as well as of its power and capacity of overcoming, and, as it were, trampling upon these circumstances.

But when we turn our attention to the other inhabitants of the American continent, we find man in his colour, and in most of the essentials of his character, proof against the variations of climate; and the hunter who drives the wild animals in the inhospitable neighbourhood of Slave Lake might, without any inconvenience, or, language excepted, almost any means of noticing that he were a stranger, range the continent from the one extremity to the other. Habits, no doubt, affect the individual there, as well as in other parts of the world. Vigorous exercises brace the frame, while indolence dwarfs and softens it. The Mexican or the Peruvian, squatted beside his hut, and finding his food from a few banana trees which cost him very little trouble, is not half so much a man as the Araucani in his forest, or the Indian, who, mounted on his wild horse, sweeps the wide extent of the Pampas, free and fleet as the wind of heaven. It must, however, not be lost sight of, that, if not different races, the Mexicans and Peruvians have long been subjected to very different treatment; and treatment, too, the effect of which has been moral rather than physical. The tyranny of the Mexican emperors and the Peruvian incas seems to have been severe enough, but it was nothing to the yoke laid upon those ill-fated people by Spain. We speak in terms of horror of the cruelties which have been perpetrated upon the natives of Africa, in the cultivated colonies of the western world; but these are nothing in point of hard labour, privation, or even direct and palpable torture, to those which the native Indians have borne in the mining districts.

These circumstances are not mentioned with any view of preserving the memory of deeds which cannot be repaired, and therefore had better be lost in the contemplation and construction of a better system; but they do show that, in considering the relative adaptations between a country and its living inhabitants, man must be treated separately and in a different manner. In the other animals, the organisation is wholly at the control of physical circumstances, though, true to its origin, it maintains its specific character in spite of them, and always resumes the natural form of that character in proportion as the modifying circumstances are relaxed. But in man there is always an active principle, which, however dormant it may be, is capable of reversing the order of physical circumstances, and creating a country for itself in the forest, the marsh, the desert, nay, under peculiar circumstances, and through the excitement of powerful moral stimuli, in the very sea itself. See MAN.

But when we leave man and his moral excitements and mental resources out of the question, the adaptations of the American mammalia to the country which they inhabit becomes a very interesting and useful portion of natural history. Not that we are by any means to conclude that they are the very best adapted to the country, even before the plough and the spade have brought it within the limits of cultivation; for such is the adaptation of the whole earth to the purposes of man, that if he will but bring the requisite degree of skill and labour to the work, and often the labour requires to be very light, he is certain to effect improvement. When the plains of Brazil and Paraguay were first visited by Europeans, there was not one grazing animal in the whole wide extent; and those who first turned loose upon them a few cattle and horses, had probably neither wish nor idea that those animals should become the staple wealth of the country. Yet such has been the fact, and the animals appear to have in a great measure grown their own food. They have kept down the long and wiry stems, brought something like a sod over the surface, and actually in fact prepared the land for cultivation by the plough; the same result, although more recently, and to a less extent, has taken place on some of the plains in the interior of Australia; and places where, only half a century ago, a few kangaroos, leaping from one tuft to another, found a scanty subsistence in the midst of a wilderness of showy but unprofitable plants, now look green and feed large and extensive flocks and herds. These circumstances seem to indicate that, in whatever hemisphere or part of the world man is to become a cultivator, he must, in order to act with proper and permanent effect, become a shepherd and a herdsman; and these two are the resources to which he must look for remuneration when the strength of his cropped land begins to fail.

The most remarkable general circumstances about the native mammalia of the American continent, are the number of species, the few of these which are common to America and the other parts of the world, and their local distribution in latitude within America itself. Of *handed animals* (*quadrumana*), about 82 species out of 187 (or thereabouts) are peculiar to America, not one of them being found in any other part of the world, and none of those of the other parts being found there. Of bats there are about the same number of American species; and though there are 112 of these in the other parts of the world, and only 102 of the handed animals, they are as peculiar to the American continent. If we leave out of our estimate the seals, which being marine animals, may be supposed to range freely round the polar seas, we have only about eighteen species of carnivorous animals (including varieties) which are common to America and the eastern continent; and some of these are aquatic, and even partially marine, while others can range from continent to continent upon the ice. But there are about 106 species of carnivorous animals peculiar to America, not one of which is found on the eastern continent; and it is probable that, from the vast tracts which remain yet to be explored, the number may still be considerably augmented. The marsupial animals of America, of which there are eight known species, are all peculiar to the country; and so are the twenty species of toothless animals, and the six pachydermous. Besides the few carnivorous animals that have been mentioned, the only species of land mammalia common to the two continents, or any part of them, are seven rodentia out of 133; and among these there are the beaver and the water-rat, both to a certain extent aquatic animals; and two ruminating animals, the reindeer and the elk; and in the species which are considered as identical, there are some variations.

All the mammalia which are common to the two continents, even to the extent of being considered as climatal varieties of the same species, belong to the northern parts of America, and almost all of them to the extreme north, within the range of the pine forests. Two out of the seven rodentia are somewhat doubtful. These are the common rat and mouse, which, from the rapidity with which they multiply, and the chance of their being landed by every ship, are not very easily determined as natives of any country. The forests, with their undergrowth of moss and lichen, and their alternating swamps and barrens still covered with coarse vegetation, affording cover to many small animals, and resting places and abundant food to innumerable herds in the summer, are the head quarters of the northern mammalia, more especially of the carnivorous tribes and the rodentia. The greater number of these are fur animals; and the quantity of their skins which is brought from the cold country to the westward of Hudson's Bay is immense. They are races, too, which all the exertions of the hunters (and their lives are no sinecure) do not tend so rapidly to diminish as the exertions of hunters do the animals of some other parts of the world. It is the interest of the hunters themselves that close time in the forests should be a time of peace; because then, and during the whole of the hot season, the skins of the animals are of comparatively little value.

Of the carnivora of the northern parts the bear is the most formidable, just as is the case on the eastern continent; but in the southern latitudes he becomes more feeble. The grisly bear of the Stony Mountains (*Ursus ferox*) is the most powerful animal of this genus; and the spectacled bear (*Ursus ornatus*) of the southern Andes is the least formidable. As the forests yield to the progress of cultivation or the hand of time (and there seems to be a curious sympathy, or rather reciprocal preservation in forests, so that if man cuts down those that are on the better land, those on the inferior land waste away), the bears and all the other tenants of the woods will of course disappear, as they have disappeared from the British islands, and from many other parts of the eastern continent; and the elk and the reindeer will share the same fate. See BEAR. The canine race are numerous, and some of them peculiar; but all of them are confined to North America, and the greater number also to the extreme north. There are among them no species answering to the wild dogs of southern Asia, to the jackal or the hyæna. Of the feline race there are considerable numbers; but, with the exception of the jaguar of North America, none of them are very formidable, either in size or in disposition. There is not naturally in the southern parts of the country any prey requiring the strength and spring of a very large predatory beast; in the herbivorous animals they are either of the slow-moving pachydermata, or the small and timid rodentia. There are no swift-bounding antelopes, no wild asses, no wild oxen, and no giraffes, which, in one or another of their species, form the principal food of the lion in Africa and the tiger in Asia. The larger prey, and the only known American species of antelope, are in the north, and that is the dominion of the more powerful bears. The inhabitants of the tropical forests, the sloths, the monkeys with their thumbless hands, and, in many instances, their prehensile tails, and the chinchillas and other herbivorous animals which inhabit the wide plains, are the most characteristic of the southern parts of the American continent.

It is not a little singular that, though the greatest breadth of the Pacific lies between Australia, on the one side, and that of the Atlantic, Africa, and the Indian Ocean, on the other, there should be a correspondence in the possession of marsupial animals. Of these there are at least eighteen known species in America; and, out of Australia, there are few, not above two or three, species in any other part of the world, and these are met with in the south-east of Asia. It is true that the American marsupialia have very little resemblance in species to the Australian ones; but it is remarkable that these two countries, wide as they are from each other, and different as they are in many of their natural as well as their geographical features, should yet be the places which, as it were, share between them these irregularly constructed animals. See MARSUPIALIA.

We have felt it necessary to give this very imperfect sketch of the leading points in American natural history, because there is not upon that continent any important and commanding animal, indigenous to the climate and characteristic of it, that will carry us over the range. With the rest of the world it is different, in all cases where a general connexion is desirable. The *antelopes* form a key to those medial or southern parts of the eastern continent, which are still (or now) in a great measure in a state of nature; and the *kangaroos* may be made to answer the same purpose in Australia, in so far as that singular continent is known or can be judged of. But there is no such animal which we can connect with the general natural history of America; and therefore some such article as the present seemed necessary, as a vinculum to bind the disjointed parts.

AMERIMNUM (Willdenow). A genus of two species: one an evergreen shrub, the other a tree; both stove plants. They belong to the natural order *Leguminosæ;* and the generic character may be described thus:—calyx two-lipped, the upper one divided, the lower three-toothed; standard reversely heart-shaped, keel of two petals; pods on a footstalk, and membranous, flatted, upper suture straight, the lower one convex. The *A. ebenus* is common in Jamaica, and other West India islands; the timber being of a beautiful colour, and having a close hard grain, capable of taking a fine polish, it is imported into Europe under the name of Jamaica ebony, for the use of instrument and machine makers.

AMETABOLIA (Leach). In entomology, a sub-class of insects embracing the Linnæan genera, *Lepisma, Podura,* and *Pediculus;* by all modern writers and entomologists these views of Dr. Leach have been adopted; the characters of the two orders are as follows, and the genera will be given under the names of the respective families.

The great leading distinction of this sub-class is, that it consists of insects undergoing no metamorphosis.

ORDER I. *Thysanura.* Tail furnished with setæ or filaments; mouth with mandibles, palpi, labrum, or upper lip; and labium or lower lip.

ORDER II. *Anoplura.* Tail without setæ or filaments; mouth in some species furnished with two teeth and an opening beneath; in others with a tubular very short haustellum.

The first order contains two families, *Lepismadæ* and *Poduradæ.*

The second order has also two families, *Pediculidæ* and *Nirmidæ:* these will be treated of under the respective heads.

AMETHYST. A mineral belonging to the quartz family. It is of a reddish or yellowish violet blue colour, and in its pure state of nearly the same degree of hardness and general chemical properties as the oriental topaz and ruby. It is usually divided into two varieties, the common amethyst and the thick fibrous amethyst. The latter is found in agate veins, and is generally accompanied by the preceding sub-species.

The common amethyst, which is by far the most interesting form of this mineral, was well known to the ancients. Its form is usually that of a six-sided pyramid, and at other times that of a six-sided prism, surmounted with the same number of planes.

The common amethyst occurs in veins and cavities in the secondary or floetz greenstone of Fifeshire; it is also found at Montrose, and in the Hill of Kinnoul near Perth. Upon the continent of Europe it occurs in great abundance, and also in North and South America. See Corundum.

AMETHYSTEA (Willdenow). A single species of a pretty little blue flowering annual, a native of Siberia. It belongs to the natural order *Labiatæ;* and is not cultivated in gardens so much as it deserves to be.

AMIA. A genus of soft-finned fishes with abdominal fins, belonging to the natural family of the herrings, and to that division of them which inhabit the fresh waters, and which are most abundant in America. Their bodies are covered with large scales resembling those of carp; but the head has no scales, and is armed with hard bony plates. The air-bag is cellular. They have the teeth strong and conical, and the point of the under jaw is fortified by a buckler of bony substance. The nostrils are tubular, the dorsal-fin is much produced, and the anal one is stout. There is only one species known (*Amia calva*); it is an inhabitant of the rivers of Carolina, and understood to feed upon crabs. The flesh is not esteemed as food.

AMIA. An ichthyolite, figured by Cuvier, and referred by him to this genus of fishes, is described by Blainville as found in a block of gypsum. It is twelve inches long and four high; the head being equal to one-third of the length. Another species is described by Mantell, in his "Geology of the South-east of England," as found in the chalk near Lewes; it is distinguished from the former by the angular shape of the head, the anterior dorsal fin having spinous rays, and by the scales being of a scabrous structure; he has named it *A. Lewesiensis.* Among other curious particulars mentioned respecting this fossil, he states that several specimens not only exhibit the tongue and its papillæ in good preservation, but even the air bladder, which appears of an elongated oval form, situated in the abdomen, immediately under the spine; thus proving that parts of the most delicate structure may occasionally be found in good preservation in a mineralised state.

AMMOCÆTES. A singular genus of cartilaginous fishes, of which the bones are so soft and flexible that they hardly deserve the name of bone.

There is only one species, the *pride*, or "stone-grig" (*A. bronchialis*), a native of some of the rivers of England, and especially those of Oxfordshire, but even there it is not very abundant, it lives in the tough and clayey mud, for which the streams in that part of England are remarkable, and it has many of the habits of a worm. When full grown it is about eight inches in length, and of the thickness of a goose-quill; and its body is annulated or marked with rings, which add to its worm-like appearance. In external appearance it is a miniature of the lamprey; but the maxillary ring or sucker, and, indeed, the mouth altogether, is without teeth, having instead small reflected barbs or bristles, on the palate and the entering of the gullet. When it breathes, the water is received by the gullet, and passes into the gill-cells, and out again by the gill-openings in the sides. This mode of breathing is incompatible with adhering to substances by the mouth as a sucker; and the upper lip only has the sucking form and character, so that the fish is inaccurately named the "lesser river lamprey." Its tail is lancet-shaped, by the dorsal and anal fins meeting in a point without any caudal. Its general habits, mode of feeding, and time of breeding are but little known, and it has not been ascertained to migrate. The probability is that it follows the general law of the mud fishes, and breeds in the very hottest season. Its size and general appearance have caused it to be sometimes confounded with the small lamprey (*Petromyzon plānare*).

AMMODYTES, the launce, or "sand eel," a genus of soft-finned bony fishes without ventral fins, and belonging to the eel-shaped family, but not partaking much of that shape or of the general characters of the eels. There are two species: the common launce (*A. tobianus*), which is seldom found more than five inches in length. It is a beautiful little fish, of a bluish green on the upper part, with a straight line of darker on each side. The under part, the head and the irides are silvery, and there are silvery reflections on the darker parts. The dorsal, anal, and caudal fins are all separate from each other; the dorsal begins behind the pectorals; and the caudal is forked. The head is very slender, the upper jaw in ordinary states is the shorter, but it can be protruded. The other species (*A. lanceolatus*) grows to a larger size, is more slender in proportion to its length, has the dorsal fin commencing as far forward as the pectorals, and the upper part more inclining to silver grey. They have no air bag, or cœca to their intestines. They feed upon worms and the smaller naked mollusca, boring in the sand with great rapidity.

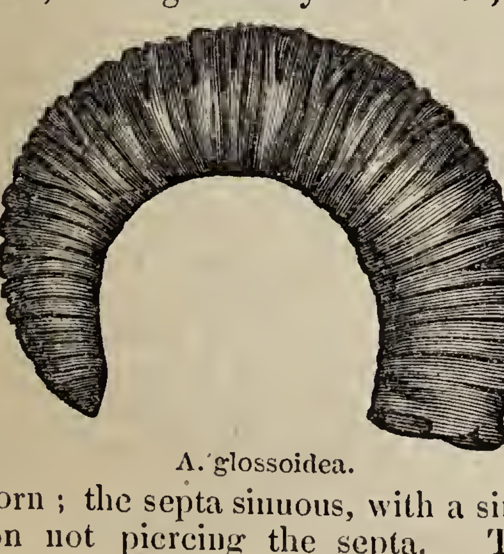
Though but of small size, they are very interesting fishes. They are caught in great numbers, are excellent eating, and much valued by the fishermen as bait. They are understood to form the principal food of some of the more valuable fishes, especially of the salmon when these are in the estuaries of the rivers, and in highest condition. The small sandy bays, at the confluence of the lesser streams with the sea, especially where those streams flow through fertile districts, are their favourite haunts; and the catching of them is often a work of much bustle and amusement. The favourable time for them is the spring tide ebb, and the further that the tide ebbs back the better. It is better also in the morning or evening, than in the heat of the day; and best of all, on those dark and still evenings when evaporation is nearly suspended, and the sands continue wet, and reflect the forms of the people; that state of the weather increases sound as well as sight, and it enables the sand worms to remain near the surface, over a large portion of the beach; the consequence is that the launces are all on the *qui vive*, driving through the sand in all directions, occasionally jerking into the air, but instantly hiding themselves in the sand.

When circumstances are thus favourable, the villagers muster *en masse*, men, women, and children, armed with spades, and shovels, and baskets, and pails, and all manner of utensils, that will turn up the sand, or hold the prey after it is captured. As soon as they come near the margin of the water, the shovelling, and scraping, and scrambling, and shouting begin; and no nutting, or even vintage, can be more joyous than this midsummer harvest of the sea. And it requires all the agility of the youngsters to secure the prize; for though the spade will sometimes disclose a dozen or more, not above one or two are caught, and all hands are searching to regain the fugitives. The very dogs seem to enter into the sport; for they skip about, and whine, and bark, and scrape, as if half the work rested upon their shoulders. It is indeed a most amusing time; and as the fishes, when the beach is favourable, recede and return with (that is near) the water, it may be continued till each family fills a large pail or basket.

Even the gulls seem to know that there is something going on which is a sort of invasion of their territory; for they wheel, and wail, and scream, now menacing the dogs, and anon attempting to assail the baskets, in the hope of regaining part of what has been taken from their preserves. The salmon, too, appear to look on at no great distance; for the porpoises come so near land as to be in some danger of grounding; and when that is the case, salmon are not far off.

AMMONACEA (Blainville). A family of molluscous animals, which includes the genera discorbites, scaphites, ammonites, and simplegas, all of which are fossils, and will be more fully described under their respective names. The animal being totally unknown, the general characteristics of these shells can alone be given; they are, the shell being discoid, separated at short distances by very thin partitions, called septa; the sides generally very thin; the form of the shell is compressed, and spirally rolled round its first turn, so as to exhibit each convolution gradually increasing in size; the last coil larger, consequently, than all the preceding, though not to such an extent as to form a wide aperture. These volutions or coils are variously sculptured, and the chambers or divisions are perforated by several, but most generally only by one tube or siphon, which penetrates through their whole length. One genus of this family, the ammonita, attains an enormous size, while others on the contrary are microscopic.

AMMONCERATITA (Lamarck, Blainville). A genus of molluscous fossils, of the family *Lituacea*; order *Polythalamacea*; class *Cephalophora*. An arched conical shell, forming scarcely half a turn, resembling

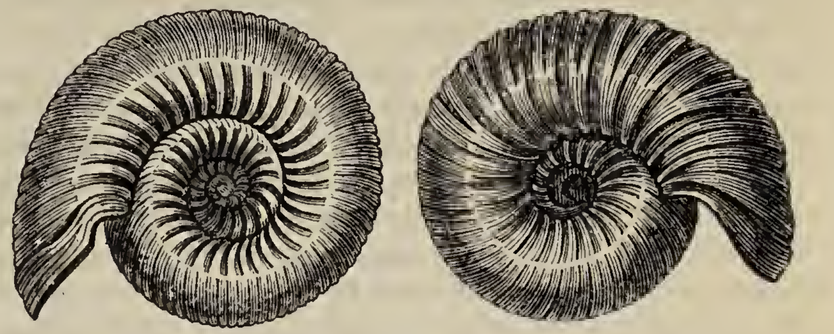


A. glossoidea.

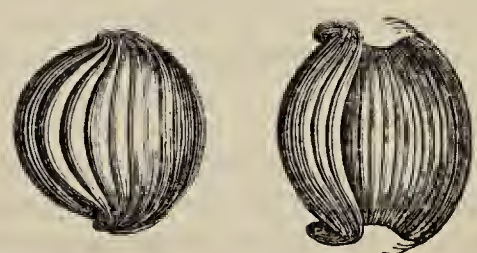
a ram's horn; the septa sinuous, with a single marginal siphon not piercing the septa. The species figured, *A. glossoidea*, sometimes attains the length of nearly two feet. They are found in the East Indies, and in Mount St. Catherine near Rouen.

A fossil shell of this genus is also known; the shell is conical, arched, but scarcely forming half a turn; the septa are sinuous, with a single marginal siphon, not piercing the partition.

AMMONITA (Linnæus, Cuvier, Blainville). A genus of fossil shells, of the class *Cephalophora*. These shells being known only in a fossil state, the



arrangement of their species depends principally upon a uniformity of external configuration; but as most of them are moulds, or internal models, another difficulty is presented, rendering any thing like a correct distribution of their numerous species into families almost impossible: there are, however, other consistent guides, such as the more or less globose form of the spiral convolutions, the keel being double, triple, or quadruple, and either knobbed or plain. But perhaps one of the best and most unerring distinctions is the sinuosity of the septa or partitions, their number and general distribution, with reference to the form of the shells, in juxtaposition with the various species. They are certainly closely allied to the nautilacea, from which, however, among other circumstances, they differ by having the mouth thickened, and in some expanded outwards, while in others it is contracted; so few of the immense number, however, are ever discovered in a complete state, that here again another guide is found deficient, in many essential points, by which a determinate character could be given to the species. The genus may therefore at present be generally described as a discoid shell, more or less compressed, the spiral turns more or less evident and convex, the aperture more or less expanded, the partitions or septa constantly sinuous, with a dorsal siphon. They are variously sculptured, but the greater portion of them resemble the marks of progressive growth or rings observable on the ram's horn, from which circumstance they have probably derived their trivial name of Cornua Ammonis, or Ammon's horn. The Egyptians worshipped Jupiter under the name of Ammon, a deity represented by the ram; and the busts and portraits of Jupiter Ammon are constantly found sculptured with rams' horns, as are those also of Alexander the Great, after he was deified as the son of Ammon.



Ammonites.

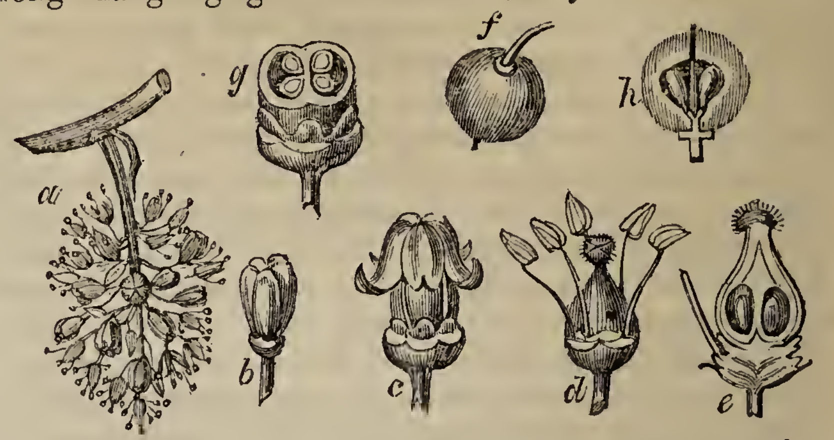
Ammonites are found in all parts of the globe; in France (particularly in Burgundy) they are so numerous as to furnish the principal material for mending the roads, and it is no uncommon occurrence to find them similarly used in some parts of Somersetshire, Gloucestershire, Yorkshire, and other counties, where they are abundant in the lias and inferior oolite formations. Large and fine specimens, in some of these counties, may often be observed built into the fronts of houses, forming an elegant natural ornament, called by the peasants petrified snakes, no doubt from the remains of a superstitious legend recorded in Camden's Britannia, exhibiting one of the many effects of our ancestors' credulity and ignorance, particularly in geology and natural history. He writes, "Upon the same river Avon, which is the boundary here between this county (Somerset) and Gloucestershire, on the western bank of it is Cainsham (now Keynsham), so named from Keina, a devout British virgin, whom many of the last age, through an over-credulous temper, believed to have changed serpents into stones, because they find sometimes in quarries some such little miracles of sporting nature. And I have seen a stone brought from thence winded round like a serpent, the head whereof, though but imperfect, jutted out in the circumference, and the end of the tail was in the centre, but most of them want the head." Walter Scott has happily adapted this legendary tale in one of his elegant poems.

These shells vary from microscopic diminutiveness to the enormous size of two feet and a half in diameter, entitling them to play their part with the ichthyosaurian, pleosaurian, and other gigantic creatures of a former world, whose race has passed away, but whose stupendous vestiges excite in the contemplative minds of us little beings awe and wonder at the vastness of creation, and the immeasurable grandeur of the Creator. See SALGRAM STONE.

AMMYRSINE (Pursh). A genus of plants of one species only; a North American under-shrub, belonging to the class and order *Decandria Monogynia*, and to the natural order *Ericeæ*. Generic character: calyx divided into five lance-shaped parts; petals of the corolla five, oval, obtuse, and spreading; stamens inserted in the receptacle, filaments like hairs, longer than the corolla; anthers egg-shaped, double; style round; stigma truncated; capsule three-celled and three-valved, seeds small and oval. This American plant is nearly allied to the *Ledums*, *Rhodoras*, and other beautiful shrubs from the same quarter of the world. In this country they are cultivated alike, and always in beds or borders of moor (not peat) earth in shady situations.

AMOMUM. A genus of plants consisting of thirteen species, all inhabitants of the warmer latitudes of the globe. They belong to the first class and order of the Linnæan system, and to *Scitamineæ* of the natural system. The generic character consists in the inner limb of the corolla having one lip, another with an entire or two-lobed crest, seeds with an arillus. This genus is allied to the ginger and turmeric families, and partakes of their aromatic and colouring properties. The *A. cardamomum*, and *A. grana Paradisi* are both extensively used in medicine, and others are useful in the arts.

AMPELIDEÆ. The forty-ninth order of the natural system. It comprises four genera, and fifty-three species. The grape vine belongs to this order, and gives a value to the whole. Its congeners are as follow, viz. *cissus*, *Leea*, and *ampilopsis*, the genus which gives name to the order. With the exception of the vine, all the plants belonging to this order are of little interest. The prevailing habit of the order is a long dangling growth of stem, thyrsus of simple



VITIS VINIFERA. *a*, a bunch of the flowers; *b*, flower before expansion; *c*, flower expanding; *d*, stamens, pistil, and germ; *e*, vertical section of the pistil and germ; *f*, fruit; *g*, horizontal section of the ovary; *h*, vertical section of the fruit, showing the position of the seeds.

colourless flowers, or tendrils opposite the leaves, and yielding bunches of berried fruit.

AMPELOPSIS (Michaux). A genus of North American climbing and shrubby plants, consisting of four species. They belong to the fifth class and first order of Linnæus, and to the natural order *Ampelideæ*. Generic character: calyx entire; petals cohering at the end, withering; stigma headed; ovary immersed in the disk, two to four-seeded. The *A. quinquefolia* is a useful plant for hiding naked buildings, or forming shady bowers, or summer screens in dressed grounds. It grows rapidly and needs no nailing up against walls, it being supported by its own tendrils.

AMPHIBIA. The third and last of the three groups into which Cuvier divides his sub-order *Carnivora*, properly so called; that is, mammalia which prey upon vertebrated animals.

The term amphibia is rather objectionable, unless received with some explanations. The old acceptation was, that animals to which the name applied, were supposed to be capable of performing all the functions of life either on land, in the air, or *under* the water; but there is no known animal that can breathe in the free air and also in the water; and, from the nature of the two fluids, as well as from the difference of the organs by which they are breathed, there is every reason to conclude that there can be no such animal. Cellular lungs, into which air is received, and fibrous gills, among the fringes of which the water plays, are so perfectly distinct, and each is so well and so solely adapted to its own purpose, that it cannot be made to perform the function of the other. The introduction of even a very small portion of water into the lungs of an air-breathing animal, would, in all the cases with which we are acquainted, be speedy and almost instantaneous death; and there is not an animal which breathes water which is not thrown into convulsions the moment that its gills are exposed to the air. Some lunged animals can, no doubt, remain a considerable time in the water, without access to the air, and some gilled animals can live for a considerable time out of the water; but neither the one nor the other so lives because it can breathe under the altered circumstances. On the contrary, it survives merely because it can live for a time without breathing; and the attempt to breathe the fluid for which it had not the proper apparatus, would occasion instant sickness and speedy death.

There are thus no amphibia, in the literal sense of the word, no animals which,

> "As some rats, of amphibious nature,
> Are either for the land or water."

There are some, as the common frog, which have gills and breathe water during one stage of their being, and have lungs and breathe air during another; but they have not even the use of the two systems for a single instant. The sealing up of the gills of the tadpole previous to their being removed from the system by absorption, as lumber for which there is no longer any use, takes place before one atom of air is inhaled by the newly perfected lungs; and when the seal of nature's condemnation is thus set upon the organs which have accomplished their purpose, they must go back to the common stock of materials, be decomposed, and again produced by the same process as at the first before they can again perform even one single movement.

What is meant by amphibia in the system of Cuvier is, therefore, nothing more than air-breathing animals, which are so formed that they can find their food, perform most of their other functions, and spend the greater part of their lives under water; and which, in some parts of their bodies at least, retain so much of the structure and appearance of animals which live habitually on land, that they cannot be classed with the CETACEÆ, or whale tribe. There are two genera of them, the seal (*phoca*), and the morse (*trichecus*); to which the otter (*lutra*), and perhaps the beaver (*castor*), might, without much impropriety, be added. Their appearances, habits, and haunts, will be noticed under their respective names. See plate AMPHIBIOUS ANIMALS.

AMPHILOBIUM. A genus of plants of which only one species is known; a West Indian ever-green creeper, considered ornamental. It is a didynamous plant and belongs to the order *Bignoniaceæ*. The calyx is bell-shaped, the limb double, outer rank spreading, undulated, or curled, the inner of two lips; corolla somewhat leathery, the tube being short, throat largely bellying, limb two-lipped, the upper like a helmet, the lower erect, having three teeth; anthers two-celled, stigma bi-lamellate; seed-vessel oval.

AMPHIPODA. The third order of the *Crustacea*, in Cuvier's arrangement of the animal kingdom. The bodies of these animals are generally compressed and curved upon the sides; the eyes are sessile and immovable, mandibles furnished with a palpus, and many of them have vesicular bursæ either between their feet or at their external base, the use of which is unknown.

Pernys.

The first pair of feet, or that which corresponds to the second foot-jaws, are always annexed to a particular segment, the first after the head. The antennæ, which, with the exception of the phrominæ, are four in number, projecting and gradually tapering to a point; the tail is articulated and styliform.

Many species of the amphipodes inhabit springs and rivulets, others are met with in the salt waters; they are always found reclining on one side, and in this position they swim and leap about with much activity. These animals may all be comprised in the genus *Gammarus*, although they are divided by authors into various sub-genera. Among the most interesting species is the *Pernys*, which is found on the coast at Rochelle, where it wages continual war against the nereides, and other marine annulata, which inhabit the same locality. When the tide is coming in, these crustacea present a curious spectacle; myriads of them may then be seen moving in every direction, beating the mud with their arms, and diluting it so as to discover their prey: when they do discover prey larger than themselves they unite to attack and devour it, which they never fail to do. The fishermen even assert that they will mount on the hurdles which contain their muscles, and cut the threads that confine them, in order to precipitate them into the mud, where they devour them at their leisure.

AMPHIPRION. A genus of spinous-finned fishes, belonging to that division of the *Scæinadæ* which have fewer than seven rays on the gill flap. They have three spinous appendages to the gill lid, only one row of teeth in each jaw, are richly coloured, and have peculiar appendages to the head. They are natives of the warm seas, but their habits and manners are very imperfectly known.

AMPHISBÆNA. A genus of serpents of very harmless and retiring character, of which, however, many strange stories are told in books, and which have been turned to account both by the sublime and the ludicrous among the poets. Milton, in depicting the most formidable of reptiles says, in sounding numbers :—

> "Scorpion, and asp, and amphisbæna dire;"

and Arbuthnot (I believe) gives much point to his satire on the two "dunces" who drew different ways in their attacks on the Scriblerus Club, where he says :

> "Thus, amphisbæna, as 'tis said,
> At either end assails,
> None knows which leads or which is led;
> For both heads are but tails."

The story was, that the amphisbæna had a head at each end, or, at all events, could move indifferently in the direction of either. What the amphisbæna of the ancients may have been it is of little use to inquire, perhaps it was the common blind worm (*anguis fragilis*), which, however, is not blind, though its eyes are very minute. At all events their amphisbæna could not have been one of the present species, which are all natives of the warmer parts of America.

They are nearly of equal thickness at both ends, so that when the eyes are closed, and the tongue, which is forky and glutinous, for assisting in the capture of the insect food, not protruded, it is not very easy to determine which is the head.

They are the most gentle and harmless of all the serpent tribe. They do not poison, or crush in their folds, or swallow with distended throats. Their mouths are small, with only a single row of minute teeth in each jaw, and their gape is narrow.

They inhabit ant-hills, and subsist entirely, or chiefly, upon the legitimate inhabitants of them. Hence they have been sometimes called "kings of the emmets," though their only attribute of royalty, if indeed that be one, is devouring their subjects by wholesale.

Gentle as they are in their manners, they are not less perfectly adapted to their way of life than the most formidable serpents of the bush. The uniform thickness of their bodies, the arrangement of their small four-cornered scales, which they can elevate at right angles to the plane of their length; and the wriggling motion, with which they twine along, enable them to move through the soft earth of the ant-hills with either end foremost.

There are several species and varieties, the best known of which is *A. fuliginosa*, which grows to the length of eighteen inches, and is of a brown colour more or less marked with white. The tail is very short, and the eyes are nearly concealed by membranes. The rings of scales are very numerous, not fewer than two hundred on the body. *A. alba* is not white, but of a pale straw colour. There are many species in the warm parts of South America and in the West Indies; but there is little interest in them. It does not appear that any of them have been found in other parts of the world. They are viviparous.

AMPHISILE. A genus of spinous-finned fishes, belonging to the natural family of those which have the mouth pipe-shaped, or small and produced. Their backs are fortified with strong scaly plates, of one of which the spine of the first dorsal fin appears to be a continuation. They, like most of the family in which they are arranged, are fishes of singular shape. They inhabit the tropical seas.

AMPHITRITES, a family belonging to the class *Annulata* of Cuvier, and to the order *Tubicoli;* they are easily recognised from the other annelides by their golden coloured setæ, which are arranged like a crown, or the teeth of a comb in one or two rows, on the anterior part of the head, where they probably serve as a means of defence, or, as the baron Cuvier suspects, they enable the animal to crawl about so as to collect the materials of its little dwelling. This name was originally applied by Muller to a generic group, to which he added the *Terebella* and *Sabella* of Linnæus. Lamarck and Cuvier have since adopted the same with some modifications, and Savigny has formed them into a family, which he divides in five genera: the animals belonging to this family have from one to three pairs of branchiæ, more or less complicated, fixed to the foremost part of the body; the feet are very unlike the other families of this order, the first pair being entirely without branchiæ, and the second, on the contrary, having a great many of them. Numerous tentacula encircle the mouth, and on each side of the fore part of the back are pectiniform branchiæ; the skin which envelopes the body is thin and transparent.

Some of the amphitrites construct light tubes of a conical figure which they carry about with them, formed by the assemblage of grains of sand, fragments of shells, and other remains, which are held together by means of a sort of mucus which exudes from the animal, and which seems to serve as a sort of glue applied in the same way that many birds and other terrestrial animals construct their nests; these animals inhabit the ocean; many of them are found in the Mediterranean, and indeed on most other sea coasts, but like all other annelides and soft-skinned animals, their history is very obscure, and in all probability will long remain so, from the little interest they excite, although no doubt they also have an important part to perform in the scale of creation.

AMPHIUMA. A singular genus of Batrachian reptile, which is described as inhabiting the waters of certain parts of the American continent. This, as well as several other analogous genera, which are all American, resemble the common water eft, more than they do any other British reptile; but some of their characters are so peculiar that they stand alone. In their physiological character they resemble the frog, though they differ less or more from that animal, according to the genus. In the first stage of their lives they are tadpoles, living only in the water, breathing by gills, and having swimming tails, but not even rudiments of feet. As they advance to maturity, lungs are formed, and four or two rudimental feet are produced; and these changes are in some instances accompanied by an absorption of the gill, so that they afterwards breathe air by means of lungs only. In other cases, however, the gills remain as well as the lungs, and they can use either system at pleasure.

The genus under consideration have the body long, and bearing some resemblance to that of an eel, only the tail is more pointed and they have no fins. The feet are very small, and far apart, one pair near the head and the others at the insertion of the tail. They are not adapted for walking, though from being furnished with lungs, the creatures can live out of the water. The feet are merely a sort of swimming power, though they may assist in crawling through the mud. There are two species named, the chief distinction of which is, that the one has three rudimental toes on each foot, and the other only two.

They are found chiefly in the shallow stagnant waters of the southern parts of North America; and as these are at certain seasons apt to be dried up, the double system of respiration comes into use, and they are enabled to scramble in quest of pools, breathing the air as they proceed; but when they again reach the water, they assume their aquatic habits. They are produced from spawn, something after the manner of frogs.

AMPHODUS. A climbing evergreen perennial, a native of Trinidad. The flowers are diadelphous, and of course arranged in the order *Leguminosæ.* The calyx is bell-shaped, in five divisions, each oval-shaped, the upper ones approximating; vexillum turned back, with inflexed teeth at the base; filaments leaning back, keel narrow; pod linear, flattened irregular.

AMPULLARIA (Cuvier, Lamarck). *Helix* (Linnæus). A shell of the second order, *Asiphonobranchiata;* the third family, *Ellipsostomata* of Blainville's System of Malacology.

The animal is globose, spiral, the foot oval, with a transverse groove at its anterior side; the head large; the upper tentacula very long, conical, and sharp pointed; the eyes situated at their external base, and supported on a very delicate peduncle; mouth vertically situated between two horseshoe-shaped lips, forming a species of snout; no upper tooth, a bristled lingual cord, but not prolonged into the abdominal cavity; the respiratory cavity very large, divided into two parts by an incomplete horizontal separation.

The shell is thin, globular, inflated and umbilicated; the spire very short, the last turn larger than all the others united; the aperture oval lengthwise, not so wide as it is long, the edges united, the exterior lip sharp, and without any callosity; the operculum is generally horny (though some species have it calcareous), thin, oval, without a spire, but formed in concentric circles, obliquely overlapping the right side of the aperture, but attached to the left side in a small groove. These shells sometimes attain to a great size, and probably it is one of the species, the *Ampullaria crassatina,* whose inhabitant formed a gastronomic delicacy at the repasts of the luxurious Romans, by whom they were kept in stews called cochlearia, and fed upon bran and wine-lees, till they acquired an enormous size, and possessed the desired degree of juicy perfection. Varro, indeed, informs us that they sometimes were able to contain ten quarts or more; a size so incomparably greater than any thing subsequently seen, that the assertion is evidently founded in an error as to what measure *his* quarts really contained, and it needs no learned commentator to prove the fact, since Pliny the younger, whose temperance formed a theme of praise to his friends and contemporaries, used to provide for each of his guests a supper consisting of *three snails*, two eggs, a barley cake, with sweet wine and snow. This delicacy is said to have been introduced by Fulvius Hirpinius a short time before the wars of Cæsar and Pompey; after which they were regularly imported from the interior of Africa, Asia, &c. in vast quantities, forming a considerable article of commerce. Ampulla, from whence their name is derived, was a small wide-mouthed bottle holding a given measure of liquid, and it is most probable that these snail shells, in their greatest size, were capable of containing some quantity bearing a relative proportion to that quantity, whatever it may have been.

This genus is evidently intermediate with the Paludinæ and Naticæ, and the species now constituting it, are probably all fluviatile. Lamarck enumerates eleven; and all of those whose habitats are known, come from the rivers of Africa, India, and South America: none have been found in Europe or North America. Several species are found in a fossil state.

Ampullaria rugosa.

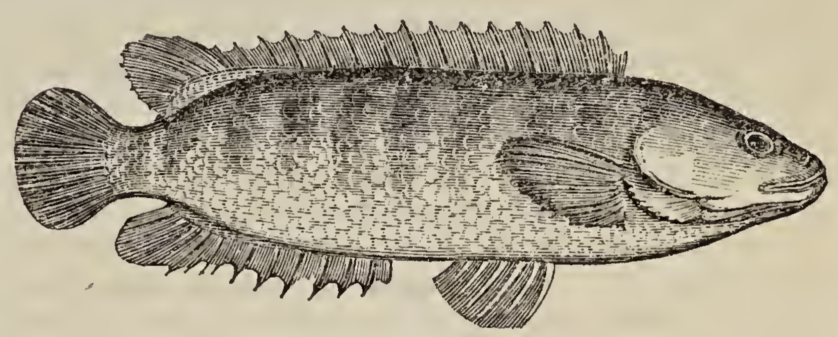
Blainville forms three divisions of the Ampullariæ. The first he calls normal or dextral, of which the figure given of the *Ampullaria rugosa* is the type; the second is sinister, or with the whorls turned to the left hand; and the third sinister shells, of which the very wide umbilicus is spirally carinated.

AMSONIA (C. Amson). A genus of three species of herbaceous perennials from North America. They belong to *Pentandria Monogynia* and to the natural order *Apocyneæ*. They are pretty little plants, and easily propagated by cuttings or by dividing the roots.

AMYGDALOID. A geological term descriptive of one of the varieties of the trap-rock formation. The base of amygdaloid is described by Brongniart as being petrosilex (compact felspar). Dr. Macculloch observes that the base is commonly indurated clay. Clay, claystone, and compact felspar, are described as passing into each other; nodules of various substances imbedded in a base or paste of petrosilex or indurated clay, constitute amygdaloid; it is therefore a *porphyritic* rock, but the imbedded substances are occasionally wanting, when the rock becomes simple, at least in appearance, and is closely allied to cornean; but when the nodules have disappeared through disintegration or decomposition, leaving the cavities they once occupied, the rock resembles a cellular lava. The minerals most commonly imbedded, are agate, quartz, mesotype, analcime, stilbite, chabasic, prehnite, carbonate of lime, green earth, lithomarge, and iron pyrites. Amygdaloid generally occurs in large masses, rarely in veins. The traprocks of Derbyshire are sometimes amygdaloidal.

AMYRIS (Myrrh scented). A genus of tropical trees and shrubs from South America. They belong to *Octandria Monogynia*, and to the natural order, *Terebinthaceæ*. They have a calyx of four persisting teeth; having clawed petals situate below the germen; stamens shorter than the petals; gynobasis thick and formed like a disk; germen one-celled, stigma sitting; drupe a papery nut. The resinous gum of some of the species is an excellent perfume; almost all of them produce some valuable gum or resin. *A. Gileadensis* produces the celebrated "Balm of Gilead." It is a shrub with purplish branches, with crowded ternate leaves, and protuberant buds, loaded with balsamic resin.

ANABAS. A very singular genus of spinous-finned fishes belonging to Cuvier's family of *Pharyngiens Labyrinthiformes*, or those which have the upper part of the pharynx furnished with little branch-like appendages and cells. This formation, which is peculiar to this family—a family consisting of only a few genera, all of them natives of warm climates, and most of them inhabiting fresh water—enables the fishes to subsist for a longer or shorter time out of the water, as they can keep their gills moist by gradually discharging the water contained in the labyrinthal sacs of the pharynx, and thus breathe freely after the body is completely dried. Hence they are often found marching, in such fashion as fishes can march, along the dry land, climbing the sides of tanks and ponds, and even, in the genus under consideration, climbing trees, though the last feat is a little doubtful. There is no question, however, that these fishes are sometimes found alive with their bodies perfectly dry upon dry land; that they leave the water voluntarily, or at least, without being forced out of it by enemies, as is the case with the flying fishes of the warmer seas; and that when the purpose of their land journeys is accomplished, they return to the water, and resume the functions of fishes there.



Anabas.

This curious habit in fishes was known to the ancients; and Theophrastus expressly mentions little fishes resembling mullets, which leaped out of the water, and could climb. There is no doubt that he alludes to the genus *Anabas*, which is very common in India, and was, in all probability, seen during the expedition of Alexander, and probably known to the Egyptians long before that period. It does not appear, however, that the ancients were at all acquainted with the peculiar organisation, by means of which these fishes are able to breathe with gills when on dry land, and exposed to the ardour of an Indian atmosphere; for, at that time, the exact correspondence between structure and habit, which forms so beautiful a part of natural history, was but little understood or attended to; and, as was the case in many other matters, instances of the most perfect design and adaptation, were described as prodigies, or departures from the ordinary course of nature. The monsters with which the fertile imaginations of the ancients peopled all countries which were imperfectly known, had all probably some foundation in nature; and were it possible to trace them to these, it would be both amusing and instructive—amusing to see upon what slight foundations fancy can build its structures, and instructive in preventing us from falling into similar errors upon subjects with which we are but imperfectly acquainted.

Fishes of this family are adapted to those climates where the seasons are divided into rainy and dry, much of the surface flooded, or covered with pools of water during the first, but parched up during the second. During the rains and floods there is, of course, abundance of fishes' food in the waters; and it is a law of nature, that where there is abundance of food, there will be a corresponding abundance of consumers. Those creatures on which the fishes feed, are of much more rapid growth than the fishes. Many of them are in the egg state during the drought, in which state they can, without injury, bear a very great degree of dry heat; and others of them are deep in the earth. The state of these last, during the arid season, is not well known; but it is probable that they remain inactive, just as snails and slugs do with us when the weather is dry. At all events, the water is peopled almost as soon as it falls to the ground, and the fishes soon come to the feast.

This rapid stocking of the waters upon what was only a few days previously a parched desert without any living creature, no doubt led to the vulgar belief of the spontaneous generation of the myriads of small animals, and the raining of fishes from the sky, though there may be instances in which the latter are taken up by water-spouts, in like manner as dust and leaves are taken up by whirlwinds upon land.

The doctrine of spontaneous, or equivocal generation, though subversive of the very foundations of rational philosophy, appears to be one which flits onward before the progress of knowledge, and attaches to one subject as soon as another is freed from its influence. It is easy to see the reason; we confound the relation of coexistence with that of succession, and thus call the one of two accompanying phenomena the cause of the other; and if we find this still done in matters of which our knowledge is imperfect, we must not expect that more ignorant ages could be more philosophic than ours. We see the larger steps of the process, but the little ones are concealed, and so we treat them as if they were nonexistent. It is not long since the belief of the actual production of animalculæ by infusion was pretty general; and now that more careful observation has disproved it, at least in many of the species, the restless spirit of speculation has taken up a sort of theory of the spontaneous vitality of the elementary *monade* of matter. [See Animalcula.] If this disposition *to make things their own causes* (and that is the direct and immediate effect of the doctrine) is kept in its own place, there is no harm. Its place is the unknown; and though it may be somewhat sinuous and screw-like, it is "the screw of the augre," by which that instrument is drawn forward, and enabled to open a passage for the direct and straightforward light.

When the creatures multiply so fast, as they do in the seasonal waters of the tropical countries, there is always a disposition to attribute them to the weather, or the other palpable and striking circumstances under which they occur. We have all heard of "blight winds" and "insect-breezes," as the actual parents of the pests of our vegetation; and we find the birds that keep them down, endowed with much more wonderful powers than the fishes under consideration. When the season requires it, the bird flies guideless to Africa; and as the season again comes round it returns true to its time.

The portions of the earth which require fishes capable of locomotion upon land are peculiar—India, tropical America, and some other places. As much of the flood water there passes off by evaporation, the fishes cannot follow the flood so easily as in more temperate countries; but they make their way from pool to pool; so that not more of them are stranded and perish by drought than in the floods of our own rivers upon the meadows.

Of the genus *Anabas*, there is only one known species, *Anabas testudineus*, the climbing perch (*Perca scandens*) of the older naturalists, which is represented on the preceding page.

The leading characters are,—the appendages to the pharynx much produced and complicated; the body round; the head large and obtuse; the mouth small; the body covered with large strong scales; the gill-lid and margin of the gill-opening strongly toothed, and the gill-flap without any tooth, and consisting of five rays. The dorsal and anal fins consist of many spinous rays. They are found in all those places of India which are adapted to their habits.

Their colours are, dull green on the upper part, fading into paler on the sides, and yellowish below. The dorsal fin consists of seventeen spinous rays; the anal of eight; the pectorals, which are obtuse, of twelve each; and the caudal of six, with one spinous ray in each. The time of breeding and most of the habits are very imperfectly known; as indeed are the habits of most of the animals which are affected by the monsoons, or other changes of wet and dry in tropical climates. The seasonal waters no sooner come than they are fully inhabited with living creatures, from the most minute water insect to the largest wading bird. Many of them are migratory, retiring to the shores and estuaries of the rivers, as is the case with the adjutants [see Adjutant]; and others flitting from country to country, as the cranes; but there are many which have not the means of migration, and indeed have no place to which they can go. A creature fitted for living in the shallow fresh water which stagnates in every hollow during the rains, could not live in the sea, or in the running waters, even if it had the means of getting there. The annual animals, or those which, like the insects, pass through a dormant or chrysalis state before they arrive at their perfect form, are no doubt in that state, or in the egg (in which most of the smaller animals can be preserved for years under even great variations of temperature), proof against the ordinary seasonal changes of any part of the world. Mollusca and reptiles too, and other species which live for several years, and do not undergo changes, have their periods of torpidity induced by drought as well as by cold. As long as there is food for insects, there is also food for lizards in those arid seasons; but when the surface for a great extent, is reduced to mere sand, the flies and other insects perish, and the lizards burrow in the sand and become dormant. Whether any of the fresh water fishes of tropical countries become dormant in the remaining waters during the time of the drought, in the same manner as, with us, eels become dormant in the ooze on the shores during the cold of the winter, is a point which, though interesting, has not been ascertained. It is at least probable, inasmuch as the numbers of fishes belonging to this curious family, to be met with any where during the dry season, bears no proportion to those which appear almost contemporaneously with the rains; and the intervals between one portion of water and another are often too great either for the supply of water in the labyrinths to moisten the gills, or for the locomotive powers of the animals. The progressive motion of the genus under consideration has not been very carefully noticed; but there is no doubt (from what has been observed of analogous genera in Guiana) that the chief organs of motion on level ground are the pectoral fins, by the action of which the animal wriggles along something after the fashion of a seal. The fish seems to have some means of measuring distance by the eye, even out of water where the bank is low; if the state of the water warns them that it is time to depart, they will leap clear out of the water and on the top of the bank; but if the bank is more elevated, they climb, in which progress they bring their fins and also their tails into action.

There is here a very curious point, which appears to show that though the eyes of fishes are differently formed from those of man or the other land animals, they are subject to some optical deceptions. Those fishes which come upon land in their migrations, whether they work chiefly by their fins, as the *anabas* and the analogous genera, or by wriggling, as is the case of eels, never attempt to leap at banks of earth or breasts of dry rock which are too high for them, while those which ascend in the water only are incessant in their attempts, even where those attempts seldom succeed. In the season when instinct leads the salmon to ascend the streams, they may, in many of our own rivers, be found making continual attempts to surmount those cascades above which a single salmon has never been found; from which it should seem that the descending water deceives their vision, much in the same manner that we imagine that the sea billows are rolling ashore, even when the whole mass of the water is ebbing away with the tide.

It is worthy of remark that there seems to be some analogy between the labyrinths of these fishes and the water-cells in the stomach of the camel. It is true that the animals require the water for very different purposes, or at least for very different immediate applications. To the camel it answers the purpose of drink; but to the fish it immediately answers that of respiration; and though "to drink *like a fish*" be a common saying, it is very probable, nay, it is almost certain, that fishes do not drink. Even in land animals, though the fact has been but little attended to by writers on physiology, it should seem that the grand purpose of drinking is to moisten the organs of respiration. At all events, the great waste of aqueous humidity is by the lungs; and when one is parched with thirst, the breathing is always painfully hot and laborious. If this view of the matter is correct, and it agrees well with the observed facts, there is much less difference in essential act between breathing by lungs and breathing by gills, than the usual theories on the subject would lead us to suppose. It has already been mentioned (see Air) that fishes and other aquatic animals do not, and cannot, separate the oxygen which is necessary for the arterialisation of their blood from the water by a direct and immediate decomposition of that liquid. They breathe the air which is in the water, and if the water contains no air they are suffocated as certainly and almost as speedily as if there were no water there. The quantity of air which they require for that purpose is much smaller than that which is necessary for mammalia, as birds, and the surface at which they receive air is much more limited; and as that surface is moistened by the water in which they for the most part reside, they do not require that apparatus which, though it has not been clearly pointed out by anatomists, land animals possess for the moistening of their breathing surface. But, in all cases, it appears that if, by any means, the breathing surface can be kept duly moistened, respiration, and with that all the functions of life, can go on in the animal; and that, as long as the supply in the labyrinth of the one, or the cells of the other lasts, the *anabas* can live on land, and the camel endure the burning heat of the desert.

There is another fact which throws a good deal of light upon this most important but rather novel view of what may be considered as the most important point in the whole range of natural history. Surface fishes, such as the herring and the mackerel, which live in that portion of the waters which may be considered as abounding much in air, die almost the instant they are taken out of the water; but bottom fishes, such as the eel, will live a longer time; and in these last, the breathing surface is always less extended, and what may be called the vital action less energetic.

It does not appear that fishes have any organisation, by means of which they can bring, from any other part of their bodies, a supply of water for the moistening of their gills. It has been said that there is no reason to suppose that they drink; and there is as little reason to suppose that they absorb water at the surface of their bodies, or any part of it, the breathing surface excepted; and this accounts for the speediness of their death in the dry air, and also for the necessity of the supply of water in the labyrinths of the family under consideration.

With land animals, the case is quite otherwise. Different species have, no doubt, different absorptive powers; but of all warm-blooded animals it may be said that they have some means of absorbing moisture from the air when they are deprived of it as drink; and we know how readily all the parts of the body sympathise with and give up their humidity to the lungs when those organs are panting in agony. The rapid breathing in fatigue or in fever, parches the body; and parches it not by perspiration, sensible or insensible, at the surface (for that, when it comes, brings relief), but by a drain of moisture internally from the other parts, to moisten the lungs, which, in proportion as they labour faster, require an increased supply.

The breathing and circulation of the blood are so intimately connected, and so simultaneously affected both by exertion and fever, that we are unable to say in which the painful exertion begins; but the effect of bathing, and especially of the affusion of cold water in reducing the heat, lowering the pulse, and rendering the breathing more easy, shows that a supply of humidity highly favourable to health may be obtained by absorption.

This subject of the adaptation of animals to climate, is one of the greatest practical importance; and would, if properly worked out, throw much light upon the best and simplest means of preserving health, especially under the extremes of exposure and exertion; but, in its application, it does not properly come within the scope of natural history, though it is there that the principles are alone to be found.

The supply of water which these labyrinth fishes take with them is sufficient to maintain them in life for several hours, even when they are making considerable exertions; and if they do, as there is reason to believe they must, in some instances, remain torpid during part of the dry season, it is probable that, when they have hidden themselves in the mud, so that the action of the sun does not beat directly upon them, and they make no exertion, it may last much longer, and they may pass gradually into that state in which all the animal functions are suspended; and then, as is the case with all animals which do become torpid, they may bear extremes of temperature which would destroy them if in their active state. The subject is, however, much too new, too intricate, and too extensive for a single article. See Animalcula.

ANABATES. A genus of birds belonging to the natural order of *Anisodactyles*, or those that have the toes unequally yoked, that is, the outer toe articulated upon the middle one; and also partially reversible, so that the toes can act two against two forwards and backwards, and laterally, at the same time. These are the most efficient of all the forms of climbing feet, at least in climbing the stems and large branches of trees, as the birds can run with equal ease in almost any direction. In Cuvier's system they belong to the *tenuirostres*, or "slender-billed," division of the papavers, or little birds.

Various names have been given, but it is probable that there is only one species (indeed that one is very imperfectly known), *Anabates cristatus*, an inhabitant of the thick forests of Brazil, and probably of other parts of tropical America. The European bird, which it most nearly resembles both in structure and in habits, is the nuthatch, but it differs considerably in both respects. The bill is convex in the upper mandible, something similar in shape to that of the blackbird, but without any notch. The tail is long, stiff, and wedge-shaped, and used as a point of support when the bird holds on upon the bark of the trees. The whole structure is well adapted for making way through the close and tangled foliage of those places which the bird inhabits, or for having command of the trunks and branches of the trees. It is strictly a forest bird, and seldom found on the wing in the air; indeed not very frequently any where: hence its food, mode of nesting, and other habits, are not known.

ANABLEPS. A genus of soft-finned fishes with abdominal fins, belonging to the carp family, and sometimes considered as a species of *loche*, from which, however, it has very distinguishing characters. There is but one species, *Anableps tetrophthalmus*, a native of the rivers of Guiana, and of its habits little is known.

The name *Anableps* is given because the fishes have the eyes elevated, and *tetrophthalmus*, because they appear to have four eyes. It is true that in the real structure there are only two eyes,—one retina, one crystalline lens, and one vitreous humour; but there passes a band of membrane over the middle of the eye, and forms two pupils, being the only instance among vertebrated animals in which there is even the external appearance of four eyes.

The body is cylindrical, the head flattened, the muzzle blunt, the mouth opening transverse the muzzle, with teeth on each jaw, and numerous small globular teeth on the bone of the pharynx. The body is covered with large scales, and the pectoral fins are in part scaly. The dorsal fin is small, and placed in advance of the anal. They have the air-bag very large in proportion to their size. The females are ovo-viviparous, and the young, when brought forth, are of considerable size, able to swim about and find their food.

ANACANTHES (without spines). A genus of chondropteryginous or cartilaginous fishes with fixed gills, and intermediate in their characters between the sharks and the sting rays, or skate. The genus which they resemble most in form is that of the sting-rays (*trigon*). The form of the body, as in that, is triangular; but the tail is rather longer, more slender, and without any dorsal fin, or that sharp and formidable spine from which the sting-rays have obtained their name. These fishes grow to the length of three or four feet, and are found chiefly in the warmer seas, and near the shores, rather than in the wide sea.

ANACARDIUM (Cashew nut). A genus of two species of East and West Indian trees. They are polygamous, and belong to the natural order *Terebinthaceæ*. They have a calyx of five sepals, coloured, deciduous; corolla of five lance-shaped petals with reflexed points; ten stamens inserted in the base of the calyx; anthers fixed by their backs, divided at the base, and bursting longitudinally; style awl-shaped; stigma headed; fruit kidney-shaped, cartilaginous, one-seeded, appended by a pear-shaped, fleshy peduncle called cashew nut. The following account of this curiously formed and useful fruit is extracted chiefly from Long's Jamaica. This is an elegant tree, bearing handsome corymbs of sweet-scented flowers, succeeded by an edible fruit of the apple kind, of a yellow or red colour. The fruit has an agreeable subacid flavour, with some degree of astringency. The juice, expressed and fermented, yields a pleasant wine: and distilled, a spirit is drawn from it far exceeding arrack or rum, making admirable punch, and powerfully diuretic. The dried and broken kernels are occasionally used for mixing with old Madeira wine to enhance the flavour. Some planters in the West Indies roast the ripe fruit, or slice one or two into a bowl of punch to give it a pleasant flavour. The astringency of the juice has recommended it as a very signal remedy in dropsical habits.

The cashew nut protrudes from one end of the apple. It is of the size and shape of a hare's kidney, but is much larger at the end next the fruit than at the other. The outer shell is of an ash-colour and very smooth: under this there is another which covers the kernel; between these there is a thick inflammable oil, which is very caustic; this will raise blisters on the skin, and has often been very troublesome to those who have incautiously put the nut in their mouths to break the shell. This oil has been used with great success in eating off ring-worms, cancerous ulcers, and corns; but it ought to be applied with caution.

Anacardium Occidentale.

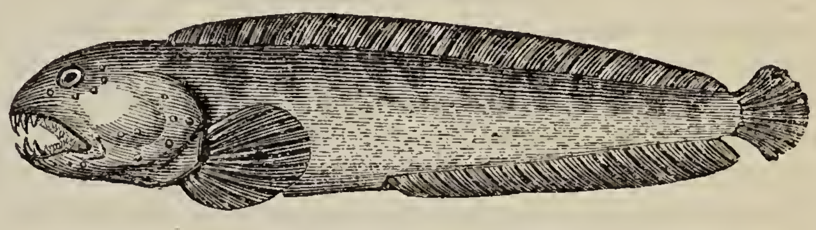
The kernel, when fresh, has a most delicate taste, and abounds with a sweet milky juice. It is an ingredient in puddings, &c. When older it is generally roasted, and in this state is not so proper for costive habits. Ground with cocoa, it makes an excellent chocolate. When kept too long it becomes shrivelled, and loses its flavour and best qualities. The thick oil of the shell tinges linen of a rusty iron-colour, which can hardly be got out; and if any wood be coated with the oil, it prevents it from decaying. From the body of the tree is procured, by incision, a milky juice which will stain linen a deep black, that cannot be washed out again. This tree also annually transudes from five to twelve pounds' weight of a fine semi-transparent gum, similar to gum arabic, and not inferior to it in virtue or quality, except that it has a slight astringency, which perhaps renders it in some respects more valuable."

ANALCIME. This mineral is generally found in granite, gneiss, trap-rocks and lavas. It occurs in the Calton Hill, Edinburgh, at Talisker in Skye, in Dumbartonshire; in the Hartz, Bohemia, and in the Faroe Islands. Analcime is feebly electrical by friction, but not by heat. The specific character of this mineral is taken from its form, which is that of a cube. Its specific gravity is rather less than 2·4.

This mineral might be confounded with borate of magnesia and muriate of soda, both of which take the cube for their primitive form, were they not strongly distinguished by their physical and chemical qualities; its specific gravity being smaller than in either of those substances. When broken it is found to be slightly undulated in the transparent portions, and compact, with a fine grain, in those which are opaque. This mineral only exhibits three marked varieties.

ANANCHYTES. One of the divisions of the Echinodermes, formed by Lamarck, and by him characterised as "irregularly helmet-formed, ovate, or conoidal. The ambulacra radiating from the vertex to the margin, and even to the mouth, which is labiated at one end, near the margin, the vent at the opposite end." Twelve species are described, the whole of which occur only in the fossil state. They have hitherto been principally found in France.

ANARRHICAS (the climber). A genus of spinous-finned fishes belonging to the family of *Gobiodes.* They obtained that name from a supposed power of climbing the rocks by means of their fins and tails; but if they have such a power at all they have it only to a small extent. They live much among the rocks, however, feeding upon crustacea and shelled animals, which they easily break by means of their powerful teeth.



Anarrhicas lupus.

The best known species is the "sea wolf" or "wolf fish" (*A. lupus*), called the "cat fish," on the shores of Scotland, where it is perhaps more common than on those of England, although it is not rare there, and is indeed one of the most common inhabitants of the sea, being found from the extreme north to nearly the most southerly latitude which has been reached, and in nearly equal numbers in the colder and the warmer climates. Its flesh tastes very like that of the larger sea eels; and it forms a staple article of food with people of many different climates and having many different manners. The people of Iceland and other places of the extreme north salt and dry it for winter store; but the negroes of Mauritius relish it in quite another style. They hang it up in the sun till it is so putrid that a European can with difficulty approach it on account of the smell, in which state it is called "ourite," and is esteemed the most delicious food that they can procure. In Britain, in Scotland especially, it is not relished, and there appears to be a considerable degree of prejudice against it, owing to its appearance.

It is indeed by no means a handsome fish; and it has a ferocious appearance, the mouth being armed with powerful weapons. Its body is lengthened, sometimes as much as six or seven feet, but it is compact; and the head rounded, something resembling that of a cat. The gape of the mouth is considerable, and the teeth, which in front are very large, strong, and of a conical shape, are displayed. The dorsal fin, composed exclusively of simple rays, extends from the nape along the whole upper part of the body; and it and the anal fin meet and form a rounded fin on the tail; the pectoral fins are also rounded. They contain sixteen rays each, the anal contains forty-six, the caudal sixteen, and the dorsal seventy-three. The general colour is brownish above and yellowish below, with darker wavy transverse branches; and the skin, though tough and firm, is without scales. The whole of the palate is covered with osseus tubercles, rather large and pointed, and the teeth in the jaws are, as already mentioned, very large and strong.

There is no air-bag, the stomach is fleshy and the intestines short.

On the British coasts it is rarely found exceeding three, or at the most four feet in length; and in the clear water on the rocky shores, where its favourite food is abundant, it is a very delicious culinary fish, especially when thoroughly boiled as soon after it comes out of the water as possible; and indeed it should seem that all the fishes which frequent rocks, and feed chiefly upon mollusca and crustacea, are firmer and finer in flavour than those that eat one another.

Formidable as are the teeth of this fish, and suspicious as is the vulgar name "wolf," which has been given to it, it does not appear that it preys upon or intermeddles with any of the other finny tribes, but goes on quietly in its rocky pastures, cracking its periwinkles, its limpets, and its other shells, and using its powerful teeth only for that purpose. The teeth stand a little forwards, so that it can take up a very small shell from the bottom, or bite the limpets from the rock; and though the fact is not fully established, it is by no means unlikely that it may sometimes rise a considerable way out of the water, and reach those which the ebb tide leaves there. The figure given in the previous page will afford an idea of the general shape of the fish.

ANARRHINUM (Desfontaines). A family containing three species of biennial herbaceous plants, natives of Europe, belonging to the Linnæan class and order, *Didynamia Angiospermia.* Natural order, *Scrophularinæ.*

Generic character: calyx five-parted; corolla two-lipped, throat open, swollen at the base, and somewhat horned; upper lip margined, the lower palated, or a little raised, three-lobed; stamens connivent; anthers three-celled; style thickish; capsule two-celled, four-valved, valves bursting.

The daisy-leaved *anarrhinum* grows abundantly in the south of France. Desfontaines also found two species in Africa, which he has named *A. pedatum* and *A. fruticosum*; and the same species Bory de St. Vincent found in Spain, in the provinces of Valentia and Andalusia: the name was given in contradistinction to the snapdragon (*Antirrhinum*), from being without the peculiar flower of that plant.

ANAS, the duck genus—ANATIDÆ, the duck family. We have taken these two titles together, and purpose noticing them both in this article, commencing with *anatidæ;* because then we shall follow the order of nature, and save both reference and repetition.

Anatidæ. The general characters of the *anatidæ* are—the bill broad and flattened, covered for the greater part with what may be considered as a sentient skin, but often with a hard nail on the tip of the upper mandible: the edges of the bill are fringed with small transverse laminæ, which, however, vary with the habits. The wings are of moderate length; the tail is in general short; the body large and flat; the legs rather far backward and wide apart from each other; the plumage in general close and difficult to be wetted; and on the under part often mixed with fine down. The characters vary much in the genera, and even in the species; but still there is a family likeness among them all.

This is one of the most important families of birds, both in a natural history and an economical point of view. In the former, it constitutes that part of the succession between birds chiefly in the air and birds chiefly in the water, which extends from the gallinaceous and wading birds on the one hand, to the true divers, which seek their food wholly under water, and chiefly in the sea, on the other. As the three motions of flying through the air, running upon the earth, and swimming along the surface of the water or under it, are more perfect in some species of birds than in any other vertebrated animals; and as, though in each species there is universally one which is predominant, and forms the chief locomotive character of the bird; there are many which possess at least two in considerable perfection, and some which possess all the three: the birds are the best class in which to study the locomotive organs and their action in relation to the other parts of the economy.

When we consider them in this way, we often find that families, which are very opposite in their characters at what may be called the one extremity, gradually approach each other, as they reach the other extremity; and that there the compound character is taken up by a new family, which, in the progress of its genera, gradually assumes a character different from the two of which it appeared to be at the first made up, and goes on changing till it again is merged in another which is in great part new. Not only this, but we can trace the order in an inverted direction, and find the characters of one family divide into two, which gradually diverge from each other till the characters of the first one are lost, and we pass to a new family on each part of the division, having no relation or resemblance to that from which we set out. If, in these analogical tracings, we take along with us both the external and the internal characters, we soon find ourselves in possession of far more useful ornithological knowledge than if we had ever so long attended to the mere characters of individuals; and indeed it is owing to this analogical mode of procedure that all the branches of natural history have, of late years, made so much progress. When we take the external form and the internal structure, compare them with each other and with the observed habits, and carry this compound analogy from race to race, we have a certain and easily used key to their whole economy; and not merely to their economy in wild nature, but to the way and the means of their domestication, and their value when that is accomplished.

The family of the *Anatidæ* is properly divided into the three genera of swans (*cygnus*), geese (*anser*), and ducks (*anas*). [The systematic names, from what language soever they are derived, are always best in the *singular* number, as being collections, expressive of the *one* set of characters in which all species agree, and not the *many* that are the foundation of the specific distinctions. The names of families, and higher divisions, are better in the plural number, as expressing a plurality of generic characters. [See Classification.]

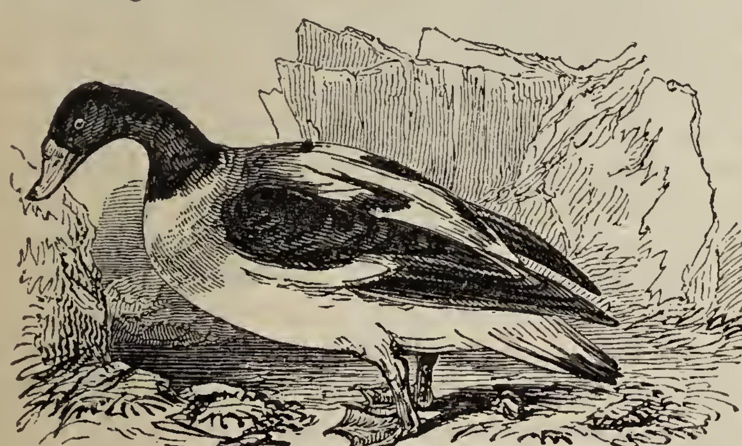
In tracing the gradation from the less to the more aquatic, it is very evident that we should end with the ducks: because many of them find their food almost exclusively in the sea, seldom come on land even for the purpose of breeding, and are very ill adapted for walking.

But when we turn our attention to the other two genera, we find some of the characters of the gallinaceous birds and the cranes so much mixed up in each, that it is not easy to say which has the greater analogy, though, upon the whole, the geese perhaps most resemble the gallinaceous birds, and the swans the cranes. The natural order of the genera is, however, usually understood to be the swans, the geese, the ducks. See CYGNUS and ANSER.

ANAS. The ducks are the smallest birds of the family, and at the same time the most numerous, and the gayest in their plumage. The general characters are so familiar to every body that it is unnecessary to describe them; for, though there are considerable differences of shape, size, and colour, there is nobody who is familiar with ducks of any species, that can easily or even possibly mistake a duck for a swan or goose on the one hand, or for one of the true divers on the other.

All the ducks can perform the three motions: they can fly, they can swim, and all of them dive upon emergency, and some of them well; and they can all walk, but some of them are bad walkers, and none of them walk either very elegantly or very fast. All of them perform their long journeys upon the wing, and most of them their shorter ones by swimming along the water. Referring to the article DUCK for the details and the economical uses, we shall devote the remainder of this article to a short notice of the natural gradation or arrangement, as the basis of which we shall take a very clear and luminous paper by Mr. Yarrell, in the 15th volume of the Linnæan Transactions.

The natural gradation, in the species which visit Britain, (and those which do not are nearly allied to one or another of these,) is from the sheldrake to the golden-eye. The first of these has in the shape and carriage of its body a considerable resemblance to some of the wading birds that frequent the shores—to the oyster catcher in particular; and were it not for the form of the bill, the length of the neck and the webs to the toes, it might be readily mistaken for a shore bird which finds its food in the banks and beaches, and does not swim. Its habits correspond: it does not go out to sea or inland to the lakes, nor does it venture into the mid water of even the narrow streams which flow into the sea. It lives mostly on the banks, just by the margin of the water, and seldom if ever dabbles so deep as to bring the axis of its body to the horizontal position. The following figure will give an idea of the form of the sheldrakes.



The Sheldrake.

The golden-eye is, in many respects, the very reverse. Its legs are so short, placed so far back, and so wide apart from each other, that it walks with great awkwardness and difficulty. But it rides beautifully buoyant upon the water, and swims along with great velocity and apparently very little effort. Its wings and tail are short, and the latter is wedge-shaped or pointed; but they are close and stiff and not easily ruffled. All its plumage is indeed so compact that it can hardly be wetted or turned upon the living bird, even though it moves backwards in the water. Its habit is to be very little upon land, not much on the fresh waters, and seldom, if ever, upon the smaller streams. The following is its figure.

The Golden Eye.

The species which are intermediate between these admit of division into at least two sections, though in some respects, these approach each other on the confines; and there are a few species which might perhaps be classed with either. One of the most obvious distinctions of these two sections is the structure of the feet. At the commencement of the first section it is nearly as much a walking foot as a swimming paddle; and at the termination of the second it is much more a swimming paddle than a walking foot. But though the sheldrake swims little and the golden-eye walks as little, it must not be supposed that the extremes of walking and of swimming feet are to be found with them. These extremes are found with the ostrich and the penguin, the one confined wholly to the land and the other to the sea, and neither of them capable of any motion in the air. The whole genus of ducks are much nearer the penguin and the seal than the ostrich are, as they all have webbed feet and can swim; and they can also call the wing to their aid when required.

The feet of the first section of ducks have the *tarsi*, or foot-bones (improperly called legs) longer and rounder than the others; they have the front toes less produced in proportion to the size of the birds, and the necks not so compact; and they have the hind toe free, or without any web connecting it to the rest, although in those species in which the sections approach each other, the hind toe has a slight margin. The legs are placed so far forward that the axis of the body can, when the neck is bent a little backwards at the middle, be carried in nearly a horizontal position. The neck too is much larger in proportion to the size of the bird; their wings are also larger in proportion than those of the second section, reaching generally to the end of the tail. In their internal structure, they have the sternum or breast bone with a much deeper keel or ridge, but not extending so far backward, or ending behind in an ensiform process or projection at the middle. The ribs extend little further backward than the sternum, so that a considerable part of the abdomen is unsupported by bone. The enlargement at the bronchial, or inner extremity of the trachea, in all of them, consists entirely of a cavity of bone. They have the stomach a true muscular gizzard; and the intestinal canal long and furnished with cæcal appendages of considerable length.

Their habits correspond with these peculiarities of structure both external and internal. They frequent the fresh waters only or chiefly; and do not launch themselves on the broad lakes, but keep near the shores and in the shallows, very seldom feeding with the whole body under water. Their food is miscellaneous, and resembles in its nature that of poultry, though some of it is more aquatic than poultry can naturally reach. They feed upon farinaceous vegetable matters, as well as upon small animals, the peculiar structure of their organs giving them sufficient digestive powers. The use of the bony enlargement of the trachea is not very well known, neither is that of the cartilaginous convolutions in those of the cranes, the swans, and the semipalmated goose. It seems, however, to be in some way connected with the habit of eating the food with the head and interior part of the body immersed in water.

The haunts and habits in feeding render it necessary that they should be much on the wing, not only on their migrations from place to place, but from one part of the shore or shallow to another: hence the length of the wings, and the depth of keel on the sternum, for giving insertion to the powerful pectoral muscles by which these are moved.

The leading species which belong to this first section are the sheldrake, the Muscovy duck, the common wild duck, the gadwall, the shoveller, the pintail duck, the widgeon, the bimaculated duck, the gargany teal, and the common teal, all of which, as well as the other species named in this article, will be described under the article Duck.

The intermediate species, which partake more or less of the characters of both sections, are the eider, the king eider, the velvet scoter, and the scoter. These are all, to a certain extent, sea ducks, rarely coming to the fresh waters; but they have no very clear distinguishing characters. The eiders rather more resemble the first division and the scoters the second. The eiders are stationary in their haunts, but they make considerable use of the wing in their daily excursions: the scoters dive more, and have altogether more of the habits of the second section.

The external characters of the second section are, the neck short and not adapted for dabbling in the same depth of water as that of the others; the wings are shorter, reaching only to the root of the tail, while those of the first section reach nearly or altogether to the tip. The tail also is close and stiff. The tarsi are much shorter and more slender in proportion; they are compressed laterally, placed far back, wide of each other, and have a sort of rolling articulation to the tibiæ. The toes are larger in proportion and the webs more complete; the hind toe is lobed, and the lobe is continued to the inner toe in a margin or web of greater or less breadth.

In the internal structure, the sternum has a much lower keel, but extends farther backwards; and toward the end of the section, where the genus may be said to border with the most duck-like of the true divers, the central portion backwards is produced in an ensiform process. The ribs also extend much farther backwards, so that the portion of the abdomen which has no support of bone is much smaller. The enlargement of the bronchial end of the trachea is a membranous sac, supported upon fibres of bone. The gullet is much more dilatable than in the first section, so as to admit of the swallowing of food in much larger portions; the stomach is still muscular, although perhaps not so completely a gizzard as in the others; the intestines are shorter, and porportionally of larger diameter, and the cæcal appendages are much shorter.

These differences, both of external appearance and of internal structure, point at different habits, which observation proves to be the same as theory would lead us to conclude.

They do not frequent the fresh waters, unless it be the deeper portions of the large lakes, neither do they dabble in the shallows, or pick up their food upon the shores. They feed much less upon vegetable matter, and more upon fish, which they catch by diving; but they also feed upon molluscous and other small aquatic animals.

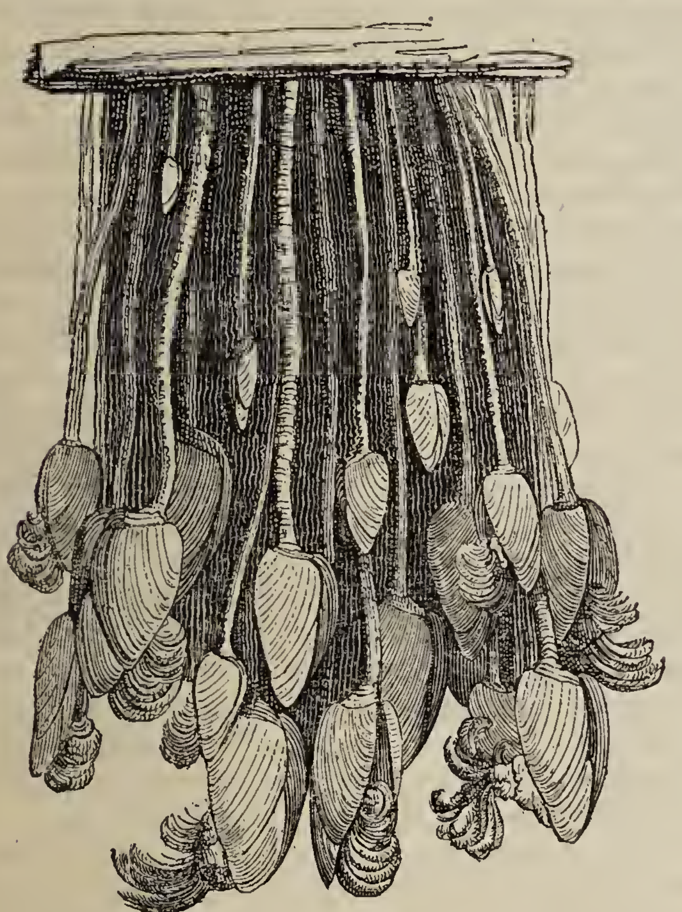
Their modes of life are more adventurous, and they can contend better with the troubled waters. They swim beautifully, dive readily, remain for a considerable time under water, and shoot along with so much ease and rapidity there, that one is surprised at the distance from the place of their descent at which they again come to the surface. Most of them are compact in their forms, and beautiful in the closeness, gloss, and colours of their plumage. One remarkable coincidence between them and the divers is, the possession of crests, more or less produced, and inclining backwards from the top of the head. In this also they have a resemblance to the herons, and many of the cranes; to most birds, indeed, which seize large prey in the water by a forward stroke of the head. The crest appears to answer a purpose similar to that of the feather of an arrow, or the long tail of a springing beast of prey—it keeps the head steady to its line.

The leading species in their order are, the red-crested, the pochard, the ferruginous, the scaup, the tufted, the harlequin, the long-tailed, and the golden-eye; the first having many of the characters of the velvet scoter, and the last a very considerable resemblance to the mergansers, which live almost exclusively by catching fish with their serrated bills.

ANASTOMUS (open-bills). A genus of birds belonging to the order of *Grallidæ* or waders; though in this and many other of the genera, Cuvier's *Echassiers*, or "stilt birds," is, on account of the length of the legs, and the birds not wading, rather more appropriate. The genus in question belongs to the natural family of the *Gruidæ* or cranes, and to the branch stork; and in their habits they do not differ much from the true storks, only that they are more shy and do not come so close or so habitually to the habitations of man. The chief difference between them and the storks, and the one upon which chiefly they have been made a separate genus, is the form of the bill, especially of the *tomia*, or cutting edges of the mandibles. In most of the tribe, whether the outline of these be straight or curved, they generally close for the greater part of their length; but in the *Anastomus*, they touch only at the base and the tip, and have a considerable opening at the middle. The basal part of the upper mandible is, however, wider than that of the under, and when the two are lapped over each other there, the tomia at the middle come very nearly into contact. It should seem, therefore, that this form of bill, though rather ungainly in appearance, is by no means inefficient in use. The tips are seizing forceps, the basal portions act like scissors, and the middle like cutting nippers. Like most of the family they are migratory birds, found in India, and also in Eastern Africa, and probably pass seasonally from the one of these localities to the other. One is described as being white except the quills and tail feathers; another as being grey of various shades, from whitish to blackish, with the same exception; and a third as having the shafts of the feathers terminated by a produced and flexible horny plate. Those which differ in colour only, are in all probability the same species at different ages; for many of the order are subject to great variations of colour with age.

So far as can be judged from the little that is said of them, they appear to be intermediate between the storks and herons, being more aquatic in their feeding than the first, and less so than the second. Of their nidification or the numbers of their broods nothing is said.

ANATIFA, or ANATIFERA. A genus of molluscous animals belonging to the class *Cirripoda*, and to the order *Pedunculata* of De Blainville, but better known as the barnacle-shell. The name of Anatifa was first given to the genus by Bruguière, for the purpose of getting rid of the name Anatifera, from *anas*, a goose, and *fero*, to bear, given to them from a ridiculous tale of early credulity, which supposed the barnacle goose to have been bred within these shells. This tale, although refuted in the thirteenth century by Albert de Grand, and subsequently by other authors, was gravely repeated by Gerard, a writer who lived in 1558, with some additional facts, said to have been witnessed with his own eyes, but which are too absurd to be repeated here.



Group of Anatifa, attached to a ship's bottom.

The body of these animals are contained within a shell, supported by a tendinous tubular peduncle or pipe, with numerous long and unequal tentacular arms, articulated and ciliated, emanating from the summit on one side. The shell is compressed on both sides with five contiguous unequal valves, the lower lateral ones being the largest. Linnæus included this genus among the *Lepades*, and De Blainville has formed of them his genus *Pentalepus*. They inhabit the European seas, where they are generally found attached to rocks, pieces of rotten timber, or to the bottoms of vessels, generally in groups, even attaching themselves to each other.

The peduncle of some of the species is very short, but it is generally long, sometimes as much as a foot; it is very flexible, susceptible of being clongated, and again contracting itself, apparently for the purpose of securing its food, as the animal is not locomotive.

Bruguière mentions that the *Anatifa* take pleasure in exposing themselves to the alternate motions of the sea, and that the species which attach themselves to vessels, prefer doing so a few inches under the water-mark, and above all near the rudder, or where the dashing of the waves is most considerable. Some of the species may be eaten with safety, particularly the common barnacle.

Several fossil shells of the *Anatifa* have been described, but they are without those indications that belong exclusively to the genus. They are very rare, and it is very doubtful whether they belong to the genus or not.

ANATINA (Lamarck). MYA (Linnæus). A genus of shells. In the modern system of conchology it is classed with the *Acephalophora*, and forms the family *Pyloridea* of the order *Lamellibranchiata* of De Blainville.

Anatina subrostrata.

The shell is very thin, semi-transparent, fragile, long, oval, gaping, and much inflated at one end, somewhat resembling a duck's bill, from which it appears to have derived its name. It is equivalve, very inequilateral. The anterior side rounded and much longer than the posterior; summits rather distant, hinge indented, the ligament internally attached to each valve on a spoon-shaped process.

ANATINELLA. A genus of bivalve shells, established by Mr. Sowerby, in his "Genera of recent and fossil shells," of which the following is a description:—"Shell ovate, equivalve, nearly equilateral, the anterior side rounded, and the posterior slightly beaked and subtruncated; the ligament is internal and fixed to a spoon-shaped process in each valve. The muscular impression of the mantle is entire, without any lining. No clavicle or testaceous appendage before the ligamentiferous process."

A few specimens of this interesting genus were brought to England by the celebrated Dr. Solander; but, owing to their imperfect state, their generic character could not be determined till the subsequent arrival of some specimens from Ceylon.

ANCHOVY (*Engraulis*). A genus of abdominal soft-finned fishes, belonging to the natural family *Clupeadæ*, or herrings, but separated from the genus

The Common Anchovy.

"herring," of which it used to form part, in consequence of certain structural differences, and corresponding differences of habit and haunt. Of the structural characters, the most obvious are, the gape extending farther back than the eyes; the maxillary bones straight and elongated; the intermaxillaries small, the muzzle small and pointed, and projecting beyond the mouth; the gill-flap consisting of at least twelve rays; the anal fin very small, and the dorsal situated immediately over the abdominals. In all the herring family the gape is proportionally shorter, the muzzle less produced, and the rays in the gill-flap fewer.

The habits of all the herring family are similar; they are migratory, and migrate in shoals; and, with the exception of the shad, and those species which frequent the great fresh-water lakes and do not migrate to the sea, they all remain in the salt water. The anchovies inhabit more equatorially than the herrings, and may be said to take up the sea where they leave it off; though, owing no doubt to currents, the smaller itinerating fishes are very apt to meet on the confines, or come a little way upon each other's ground. They also appear to follow the same law as the herrings in respect of quality —the most northerly inhabiting species are the best in flavour, and also in flesh. Out of the six or seven species which are named, the common anchovy, so well known as a zest, and as forming a sauce for almost all other fishes indiscriminately, is the only one which has attained any great degree of celebrity. One, or perhaps two other species, frequent nearly the same places as the anchovy of commerce, and bear about the same relation to it as the pilchard and the sprat do to the herring. The remaining species are found in the tropical seas, and none of them has acquired much reputation there; that may, however, depend not a little upon the mode of curing. For, in the case of the herring, there is no doubt that as well-conditioned fish are taken on our shores as the Dutch can procure; and yet a Dutch pickled herring is very superior to any thing of the name that can be prepared in this country. Haddocks, too, are certainly not worse upon many other parts of the coast than they are on the shores of Aberdeen and Kincardine; and yet the delicious half-dried half-broiled haddocks are no where prepared in their very highest state excepting on the range of coast from Aberdeen to Stonehaven. As good herrings are also obtainable at many other places as at Yarmouth; and yet there are no red herrings equal in flavour to those which are prepared there. The operations by which all these are prepared are abundantly simple, and they are said to be the same at all places; but the effect is so different, that there must be a difference in the mode.

Something may, no doubt, depend on the condition in which the fish are caught; and it is agreeable to the analogy of all the migratory fishes, and also to a well-known law of physiology, that the fish should be better when taken not too near the spawning-ground, or rather when not too near the time of spawning. When the fishes begin to shoal (for in the case of the whole family, the fishes are solitary except when they approach the shores for spawning), they are always in finest flesh and flavour; and as the roes and milts advance to maturity, they do so at the expense of the fishes, which then become comparatively thin and flavourless. This is in part proved by the fact that, in the Mediterranean, which may be regarded as the grand nursery-ground (if not the permanent head-quarters) of the common anchovy, the finest ones are obtained off the little island of Gorgona, and superior to those taken nearer the main land. The common anchovy is found in prodigious numbers along all the shores of the Mediterranean, especially the European ones, which, from their form, are of course the eddy shores, and as such abound most in food both for the fish and the fry, and also disturb the spawn-beds the least. The months during which the fishing is chiefly carried on, are May, June, and July; the best fish in May, the most abundant in June, and inferior, mixed with "shotten" ones, or those that have spawned, in July. They are found not only in the Mediterranean, but on the Atlantic shores without the Straits, along the west of Spain and Portugal; less abundantly in the bay of Biscay; rarely in the English Channel; and still more rarely to the northward of the Straits of Dover. When, however, they do make their appearance in the North Sea, it is on the eddy shore, that of the Netherlands rather than England. The fact that those fishes which come in shoals to the shores for the purpose of spawning, choose the eddy shores, just as those which feed in shoals seaward (as the common cod, for instance) choose the eddy banks upon which the revolving currents let fall their deposits, is one of much importance in the economy of the sea; and if those eddies were well ascertained and described, it would greatly extend the theory of the fisheries, one of the most useful, though unfortunately much neglected, branches of economical philosophy.

The vulgar opinion [we do not, on any occasion, use the word "vulgar," in an offensive sense, but merely as expressive of "the herd of authors, who follow their leaders as unreasoningly as sheep do the 'bell-bearer'"]—the vulgar opinion respecting anchovies is still much the same as it long was respecting herrings. They do not, like them, come from the "polar seas," but from the Atlantic, and "enter the Mediterranean in vast shoals," which, however, have never been seen choking up the gut of Gibraltar, or at all in that passage. The truth is, that, like all the family, they disperse when the spawn is deposited, and go to *the nearest deeps;* but being apart from each other there, they are just as seldom seen as the herring, the shad, or the salmon are in the offings of our own shores in the intervals between the breeding times. That they are most abundant on the northern shore of the middle longitude of the Mediterranean, and also in *best condition*, shows that there they have come the shortest distance; and that, though found in the Atlantic, it is in smaller numbers, and the Mediterranean is their grand home. The number caught every year is immense; and the only preparation they receive is said to be drawing, decapitation, and salting down in casks, containing about ten pounds on the average, though they vary considerably.

The real anchovy is about a span long; less, of course, when the head is removed; plump and round in the body; brownish blue, with a silvery lustre on the upper part, and silvery white on the under; the flesh is salmon-colour when salted; but if the fish are not in high season, it is pale as well as thin and tasteless. There is another species in the Mediterranean (*E. meletta*) which bears about the same relation to the common anchovy that the sprat does to the herring.

It is said that the anchovies of commerce are often adulterated with an admixture of the sardine (*Clupea sardina*), a fish very much resembling the pilchard, only smaller in size; but as it has neither the colour nor the flavour of the anchovy, it can be used only in mixture with that.

The trade in anchovies is very considerable, and the quantity annually imported into Britain is not small. The time when it became so general a seasoning for fish is not precisely known; but it was used as a sauce or pickle of some sort or other in the time of the Romans. It is a curious fact, that the anchovy does not improve the flavour of any of the family to which it belongs.

ANCHOVY-PEAR. Is a stem-flowering tropical tree found in Jamaica. It is called *Grias cauliflora* by botanists, and belongs to *Polyandria Monogynia* and the natural order, *Gutiferæ* (*affinis*). Generic character: calyx adhering to the germen, cup-shaped, a little four-parted, persisting; petals four, leathery; stamens many, inserted on the disk; filaments like bristles, connected at the base; anthers kidney-shaped, very small; style, none; stigma thickish, four-sided, crossed, hollowed; drupe large, each side thin, crowned with the calyx, having eight furrows; nut oblong. The unripe fruit of this tree is used as a pickle; and the foliage and flowers are ornamental. It generally grows in low moist places or in shallow water.

ANCILLARIA (Swainson). ANCILLA (Lamarck). A genus of shells belonging to the class *Paracephalophora*, order *Syphonobranchiata*, family *Angyostomata* of de Blainville. These shells are smooth and highly polished, appearing as if rubbed to an even surface by art; they are oblong oval, pointed behind, enlarged, and appear as if truncated in front; aperture oval, rather lengthened, and angular behind; not very deeply channelled in front; the columella anteriorly with an oblique callous band, and the right lip obtuse. They inhabit the East Indies, but the animal is quite unknown. Twenty recent species are described and five fossil.

The genus is distributed into two subdivisions: the first species having the spire rather elevated and bucciniform, as in the *Ancillaria buccinoides*; the second species here figured with scarcely any spire, as the *A. cinnamomæa*. This shell is chestnut brown, with white bands above; columella reddish, and somewhat striped; the length is about one inch. The name of this genus is probably derived from *ancilla*, a damsel. The columella never being plaited, readily distinguishes this shell from the volutes, with which Linnæus had blended it; and the callous oblique thickening at the base of the columella, separates it from the terebellum, but it appears closely to approximate to the genus *Eburna*.

A. cinnamomæa.

ANCYLODON. A genus of spinous-finned fishes, belonging to the family of *Scienoideæ*, the type of which is a fish of the Mediterranean, which has been known and esteemed as food since the days of the Romans. Only one species of the present genus is named. It is a native of the warm seas, but neither its haunts nor habits are known, any farther than can be inferred from its structure; and there are no animals of which museum specimens are, not so useless merely but so mischievous, from being apt to mislead, as fishes: the soft parts cannot be preserved; and thus, as the internal structure is unknown, we can safely infer nothing from the skin, the jaw-bones, and the teeth. The species under consideration has but one dorsal fin; the tail is pointed; the head thick, short and round; and the teeth, especially the canines, very long, strong, and formidable.

Hence it is probable that the chief food is shelled mollusca and crustacea; that the fish is an inhabitant of rocky shores; and that, from the nature of its food, its flesh should be wholesome and palatable.

ANCYLUS, of modern naturalists: *Patella* (Linnæus). A genus belonging to the class *Paracephalophora*; third order, *Scutibranchiata*; first family, *Otidea*, in De Blainville's system of malacology.

The body of the animal is oval, conical, nearly straight, a little bent backward, with a rather large oval foot; the mantle with thin edges, not tentacular, nor extending beyond the head, which is very visible and very large; two large tentacula, cylindrical, and contractile, having a foliaceous appendage at their external side; the mouth is altogether beneath, and pierced in the middle of a buccal mass, prolonged on each side into an appendage; and on the left side the lateral branches in a sack or cavity, situated in the midst of the animal's left side, between the foot and the mantle; it is closed by an operculated appendage. The shell is nearly symmetrical, entirely covering the animal; the summit pointed and inclined backward, the base oval and smooth. Linnæus was guided in this, as in many other instances, by the form of the shell only, and consequently classed it with the patella, which it greatly resembles; modern naturalists have very properly constituted a distinct genus of it. Lamarck observes that he has only provisionally placed it with the Calyptræ; but the animal existing altogether in *fresh water*, and habitually breathing air, renders it very different from the inhabitant of the latter. Drapaunand has placed this genus following that of Lymnea, which the animal's organisation narrowly approximates; and Blainville says that, not knowing enough of the animal's organisation to class it positively, he has placed it near the Haliotidia, by a similarity in the position of the branchiæ.

They are fresh water shells, attaching themselves to flags and other aquatic plants; they are nearly amphibious; and in summer, when the brooks become dry, they remain in the soft mud until the return of rain. The minuteness of the species renders the study of these animals rather intricate.

ANDALUSITE. An earthy mineral of a red colour. It occurs in gneiss, mica slate, and clay slate, and was first found in Andalusia, in Spain; hence its name. It is now found in mica slate in Aberdeenshire, in the Isle of Uist, at Dartmoor, at Killiney, near Dublin, and at Douce Mountain, in the county of Wicklow.

This mineral is usually seen in a hard and brittle state; indeed it will readily scratch common quartz; but we are told by Herr Von Voith that the andalusite of Herzoyan is so soft in its original repository, that he could flatten it between his fingers, and cut it with a knife, but that it became very hard by exposure to the air.

ANDERSONIA. A greenhouse evergreen shrub, introduced from New Holland by Robert Brown, belonging to the Linnæan class and order *Pentandria Monogynia*. Natural order *Epacrideæ*. Generic character: calyx coloured like bractea; corolla, bottom of the limb bearded; stamens below the germen; anthers fixed to the middle; five scales round the germen; capsule contains a central placenta like a column.

ANDIRA (Lambert). A genus of two species of hot-house trees, natives of the West Indies, belonging to the Linnæan class and order *Polydelphia Decandria.* Natural order *Leguminosæ.* Generic character: calyx like a bladder, five toothed, teeth rather unequal; vexillim roundish, margined, spreading; legumen on a footstalk, round, hard, containing one seed.

ANDRENIDÆ (Leach). A numerous family of insects of the order *Hymenoptera,* and the genus *Apis* of Linnæus. The insects belonging to this family have the lip with the apex subcordate, with one auricle; generally nearly straight, but in some of the species slightly curved; in others reflexed, the tongue being shorter than the sheathing tube; the tarsi have the first joint compressed, and are of an elongated square shape. They all live in societies much in the same manner as the bees: but they only consist of two individuals, the male and female; like the bees also they collect the pollen from the various flowers on which they feed. This family is divided by Dr. Leach into three divisions, from the form of the lip. The first has the lip with the apex dilated, nearly heart-shaped; to this division belongs only the genus *Colletes,* Latreille; the superior wings with three submarginal cells; antennæ with the third joint longer than the second; abdomen much elongated, more or less downy; ocelli forming a curved line; tongue obtuse, the apex divided into two lobes. Of this genus we have three species in this country, the *Apis succincta* of Linnæus being the most remarkable; the second species, *C. fodiens,* has been ably illustrated by Mr. Curtis, who observes that we are indebted to Reaumur for a knowledge of the economy of these bees, and it is a little singular that no one appears since his time to have discovered any of their nests, which are stated to have been formed amongst some earth filling up the spaces in a stone wall. These nests are cylindrical, and composed of many cells of different lengths, placed in a horizontal line, each cell being formed like a thimble and fitted to the next; sometimes, however, when a stone obstructs their course, the line becomes irregular. The cells have alternate transverse bands of two or more colours; the shorter ones at their junction are white, the longer ones enveloping the body are reddish brown. These cells are constructed of many layers, lying one over the other; and although their contexture is close, they are very transparent in consequence of their extreme thinness—sufficiently so to discover the colour of the substances contained in them, which causes the variegated line above described.

The second division has the lip with the intermediate process oblong and acutely pointed; when at rest a little deflexed. This division contains three genera, the superior wings having two submarginal cells; genus *Dasypoda,* Latreille; maxillæ inflexed at their middle, or below; their terminal process triangular, lanceolate, and longer than the palpi; hinder feet with the first joint of their tarsi as long or longer than the tibiæ.

Only one species is described of this genus, the *D. Swammerdamella,* a very elegant insect, which has been long known, as it was in the collection of the celebrated Swammerdam, one of the fathers of entomology, and has been tolerably figured by him. Panzer has an admirable figure of it, under the name of *Andrena plumipes;* but his description of it does not agree with our specimens, which renders his synonym rather doubtful.

"No person at first sight would take the male and female of *D. Swammerdamella* for the same species, so widely do they differ in most particulars; nor should I have suspected that there was any connexion between them, had I not discovered their retreats. In the month of August, 1797, I saw a female take her flight from a grassy declivity of a southern aspect, which was much entangled with roots and shrubs. Upon examining this spot more narrowly, I discovered a number of small burrows, each of which had a little heap of sand, which had been excavated from it, lying before it. In some of these burrows I saw this insect sitting with her head at the mouth enjoying the sunshine; at the same time I observed many other insects flying about the spot. Upon my attempting to take them they disappeared, but they soon returned to their amusement. With some difficulty I at length succeeded in taking one, and it proved to be the female just described. I have since frequently visited the same spot, and at the proper season have always found these insects there, both males and females, employed in the manner I have mentioned."

A. negro-anea.

In the genus *Andrena* of Fabricius, the maxillæ are bent at their extremity; they are longer than broad; the hinder feet with the first joint of their tarsi shorter than the tibiæ; labrum or lip little elongated, shorter than its palpi. The species *A. negro-anea,* represented above, inhabits the blossoms of mallows, where it may be found in the spring. It has the body black and densely covered with tawny-coloured hairs; the head has the front covered with tawny hair; on the summit may be seen the ocelli placed in a triangle; the antennæ are black; thorax black and covered with reddish hair; wings transparent and slightly irridescent towards their extremities; the legs black and covered with brown hair; the thighs and shanks of the hinder legs beneath covered with long white hair. This bee is not uncommon in April and May. We have figured it in order to remind the entomologist of the very curious parasite that is occasionally found on it, namely, the stylops. Many species of these insects have been added since their discovery, Mr. Curtis having enumerated six species; the same entomologist has also added a new genus.

The species of the andrena are extremely numerous, and a very large portion of them inhabit Britain. Their proboscis is downy and thick. The hinder legs of the male are furnished with a floccula at their base, the tibiæ with a thick scopa or brush, and their anus is covered by a fringe of hairs. They nidificate under ground in a light soil, some choosing banks over which bushes are scattered, others bare perpendicular sections, but all seem to prefer a southern aspect. They excavate burrows of a cylindrical form, from five inches to near a foot or more in depth, of such diameter only as to admit the insect. In making these holes they remove the earth grain by grain, which they throw up outside their holes in the form of a hillock. Some species penetrate in a horizontal, and others in a perpendicular direction. They construct a cell at the bottom of this hole, which they replenish with pollen made into a paste with honey, and in this they deposit their eggs. The pollen they carry in the scopa or brush of their hinder tibiæ, upon the flocculus at the base of the hinder thighs, and on the hairs of the metathorax. When the female has committed her egg to the paste, she very carefully stops the mouth of her hole to prevent the ingress of ants, or of other insects which might be enemies to the larvæ.

The genus *Cilissa* (Leach) have the maxillæ bent near their middle, the terminal process very much longer than broad; lip elongated, longer than its palpi; superior wings with three submarginal cells, the second small. This genus is not only distinguished from Andrena by the characters of the lip and maxillæ, but also by having a longer tongue with very minute auricles.

In the third division we find the lip with the intermediate division incurved, or nearly straight, not twice the length of the head; superior wings in all, with three complete submarginal cells; it consists of four genera, the first of which, the genus *Sphecodes* (Latreille) has the labrum, trigonate, of the male entire, of the female generally emarginate; antennæ of the males long, almost moniliform; abdomen with the greater portion smooth. The species of sphecodes make their nests in bare sections of banks exposed to the sun, and nearly vertical. According to Reaumur, they excavate to the depth of nine or ten inches, and deposit their eggs in a mass of pollen mixed with honey.

In the genus *Lasioglossum* (Curtis), the antennæ of the male is inserted near the centre of the face, longer than the head and thorax, slightly fusiform, composed of thirteen joints very similar to *Halictus;* labrum transverse ovate, the sides straight, having the angles rounded and slightly emarginate; anterior margin convex and ciliated with long hairs, broadest at the base; mandible not so much dilated at the base as in *Halictus;* maxillæ very slender; abdomen ovate and convex, considerably broader than the thorax. Wings ample; the cells similar to halictus, as well as the legs.

In the *L. tricingulum* (Curtis), the male is black, shining, and pubescent, exceedingly minutely and thickly punctured, and clothed with soft ochreous hairs; abdomen with a whitish fascia, narrowest at the middle; at the base of the second, third, and fourth segments, the fifth segment slightly grey with pubescence, the apex ochreous; wings iridescent, the posterior margin slightly fuscous; stigma ochreous; nervures pale brown; posterior tibiæ ochreous; and tarsi, excepting the first pair, whitish ochre, tipped with ferruginous.

Curtis says, "this singular, and, I believe, nondescript species, appears to form a beautiful connection between the *Andrenidæ* and *Apidæ;* but, unfortunately, the female is unknown. I took three males at Ventnor, in the Isle of Wight, flying about flowers near the sea shore, the 12th September, 1826; they look very long on the wing, in consequence of the head, antennæ, and bodies, being carried horizontally."

The genus *Halictus* (Latreille) have the antennæ inserted near the middle of the face, long, filiform, and with thirteen joints in the males, the basal joint being the longest, and clothed with long feathery hairs; second, cup-shaped; third, semi-ovate; fourth, stouter and oblong; the remainder slightly decreasing in length, and becoming very ovate or convex on the under side; terminal joint rounded at the apex. The males are smaller and slenderer than the females; having the head orbicular, depressed, the eyes long and ovate, ocelli three, thorax globose; the abdomen is elliptical in the males, and ovato-conic in the females, with a groove on the back at the apex; wings superior, with one marginal and three submarginal cells, the central cell the smallest; tibiæ, with long spires or spurs; posterior robust in the female; tarsi, five jointed, basal joint long and stout in the females, the others minute; claws bifid in both sexes.

Mr. Curtis says, the remarkable elliptical impression on the back of the penultimate segment of the abdomen, distinguishes the female halieti from all other bees, and the head of the male is narrower and more elongated than in Andrena, and the second joint of the antennæ is not much larger than the second. Twenty-nine species have been found in England; they are mostly taken in the spring and summer months.

The last genus of this family is the *Hylæus* (Fabricius), in which the lip is lance-shaped, the hinder feet in both sexes being alike; the last joint of the abdomen in the females with a longitudinal groove above. The *Hylæus quadri-cinctus* is found occasionally near London. The males of this genus are remarkable for an elongate cylindrical body. The wings of many of the species are beautifully iridescent. They nidificate in bare banks, where they may be found in June, July, and August.

ANDREOSKIA (Decandolle). A genus of annual and biennial weeds found in the north of Europe, allied to Sisymbrium, and in the natural order *Cruciferæ.*

ANDROCYMBIUM (Linnæus). A family of bulbous-stemmed herbs, natives of the Cape of Good Hope. Linnæan class and order, *Hexandria Trigynia.* Natural order, *Melanthaceæ.* Generic character: calyx, corolla-like, six-petaled; sepals, long-clawed, convolved like a cup, honey-bearing; stamens inserted in the hollows of the sepals; anthers, leaning, opening outwards; styles terminating the cells of the germen, distinct; capsule, three-parted, three-celled, three-valved; cells, many-seeded, and fixed to the dissepiment in a double rank. There are three species of this family, all curious and ornamental.

ANDROMEDA (Linnæus). An extensive genus of beautiful under shrubs, chiefly natives of North America. Linnæan class and order, *Decandria Monogynia.* Natural order, *Ericeæ.* Generic character: calyx, five-cleft, coloured, persisting; corolla, bell or bottle-shaped, limb, four-toothed, reflexed; stamens, inserted into the base of the corolla, included; filaments awl-shaped; anthers, two-horned, opening by pores at the top (rarely with a back bristle or awn); style, cylindrical, persisting; stigma, blunt; capsule, five-celled, five-valved, with many seeds; valves placed contrary, opening in the middle, with a central placenta, in five lobes.

There are nearly fifty species and varieties of the Andromeda, and are usually seen in our gardens in the American borders, intermixed with azaleas, kalmias, &c. They thrive only in peat earth, or leaf mould and sand; and in their natural habitats they all affect moist situations; they are in general pretty little plants, some of them considerable shrubs, and even trees, for the *Andromeda rigida* rises to the height of about twenty feet. The beautiful red flowers of *Andromeda hypnoides* are spread over great tracts of the Lapland Alps, and assist much to adorn the scenery with their moss-like appearance. According to Sweet, they are increased by layers, and also from seeds, which must be very thinly covered with earth, and transplanted when about an inch high into pots, until they are sufficiently strong, when they may be planted out in the open ground.

ANDROSACE (Linnæus). A family of small annual, biennial, and perennial herbaceous plants, natives of the mountainous parts of the continent of Europe. Linnean class and order, *Pentandria Monogynia.* Natural order, *Primulaceæ.* Generic character : calyx, five-sided, five-toothed; corolla, salver-shaped, throat glandular, limb five-lobed ; stamens, within the tube ; capsule, five-valved, five to ten-seeded. The large round hollow leaf of the common androsace has been compared to the buckler of the ancients, and hence its name.

ANEILEMA (R. Brown). A genus of exotics, chiefly evergreen creepers requiring the protection of the greenhouse. Linnæan class and order, *Triandria Monogynia.* Natural order, *Commelineæ.*

ANEMONE (Wind-flower). An extensive and beautiful family of ornamental herbaceous plants, mostly natives of Europe. Linnæan class and order, *Polyandria Polygynia.* Natural order, *Ranunculaceæ.* Generic character : flower having an involucrum, often at a distance from the flower ; calyx resembling a corolla with many petals ; nectarium none ; stamens below the germen ; filaments like threads, sometimes dilated at top ; anthers oblong, two-celled ; style filiform, short ; stigmas headed or flatted ; caryopses naked.

Of this genus there are forty-one species described, of many of which, particularly the *A. coronaria,* there are numerous varieties ; and the structure is also so different that botanists have divided the family into six sections, founded on the different appendages of the seeds and form of the involucrum. The greater number have tuberous roots, among which the coronaria or garland anemone has been raised to the dignity of a bed flower by professional florists, and for some of the newest and best high prices are charged.

The anemone is propagated and new varieties are obtained by sowing the seed. This should be chosen from the best old flowers, impregnated with semi-double flowers, having the desirable properties of rich colour and fine form. The seed being liable to be blown away by wind, should be gathered as it ripens, and be preserved dry till the month of January, when it should be sown. It requires to be prepared for sowing by being mixed with, and rubbed in sand, to free it from its downy covering. The seed-bed should be composed of fresh garden ground or loam, from twelve to eighteen inches deep, well broken and aired, to free it from worms and insects ; and, for the better security against these, a layer of lime, three inches thick, should be laid in the bottom of the bed ; and, to prevent the approach of slugs or worms to the surface, the outskirts of the bed should be frequently sprinkled with lime-water.

A shallow one-light frame is necessary for the defence and nurture of the seedlings. In this, when the soil is settled and levelled, sow the seeds equally, and press them into the earth with a board, or back of a spade. The bed should be kept rather moist. While the seeds are vegetating the glass-light should be kept close ; and as they swell and rise above ground, a slight covering of loam may be sifted on occasionally till the seeds are hidden. Air must be afterwards given at all times when the weather permits ; and should the bed become too dry, it must be lightly watered. If the surface appear crusted when the seedlings are rising, it must be cautiously loosened with the point of a stick. This treatment must be continued till the leaves begin to die off, and when they are quite withered the tubers may be taken up.

As these small roots are irregular in form, and of a dingy colour, they are not readily found, unless two or three inches of the surface be passed through a fine sieve, to separate them from the mould. When freed from earth and dried, they are kept in boxes till the planting season.

These seedlings, planted in a nursing bed, will mostly flower in the second year ; all that are worthless may be discarded, and the best kept to breed from, or take a place among the finer sorts. The finest double varieties are only procurable by a long course of successional sowings from individuals of good colour, and which show a tendency to become double.

Anemones may be planted either in the month of October, or in February. The autumn is the most natural season, provided the bed is defended by proper coverings during severe frost. By spring planting, the risk of injury and trouble of covering is avoided ; but in highly kept flower-gardens, they are planted in both seasons to ensure success. When coverings are necessary, they should be of bass or reed mats, and raised on hoops a foot or two from the surface, and always rolled off when the weather is mild.

The habits of the anemone, as being a production of the moistest season of the year, seem to point out the soil most congenial to it; viz. a mellow, moist, rich loam. It is such as absorbs and retains an equable degree of moisture, without repletion or deficiency ; and, though surface-water be neither naturally necessary or suitable, yet a substratum of rich soil retentive of moisture is indispensable.

In forming the bed, the bottom must be loosened sufficiently deep, say two feet at least ; and, about eight inches from the surface, let a stratum of strong loam and rotten dung, well incorporated, be laid, and on this a surface layer of lighter loam to receive the tubers. The bed being formed and levelled, drills are drawn across about five inches asunder, on which the roots are placed, crowns upwards, four or five inches apart, according to their size, covering them as near as possible about two inches deep.

The subsequent management consists in defending the bed from frost, slugs, and insects. If the month of March be dry, the state of the soil should be examined ; if found too loose, a little fresh loam may be added and pressed tight to the plants ; and if too dry, a good soaking of manured water may be given, and this occasionally repeated, if dry weather prevails. When coming into bloom, shading as well as watering will be required ; as well to ensure perfect flowering as to preserve their beauty. After the flowering, and when the leaves fade, dry weather matures the tubers readily ; but if very wet, the bed should be protected from rain : because this keeps them excited, and tends to weaken them. About a month after the bloom the roots may be taken up, carefully cleaned, dried, and stored up.

There are four species of this plant found in Britain ; the wind-flower, *A. nemoralis,* and the Pasque-flower, *A. pulsatilla,* are among the gayest ornaments of the spring.

ANGEL-FISH, or "Monk-fish." The common English name of a species of *Squatina Angelus*, a genus of chondropterygious or cartilaginous fishes, with fixed gills, and in their characters intermediate between the sharks and the rays or skate. These three genera may, indeed, be considered as forming a series which, in the gradations of the different species, extends from the surface of the sea to the bottom, at least to the bottom of the shallows near the shores; and from the wide range of the ocean to particular spots, from which they seldom migrate. The white shark is the most discursive as well as the most formidable and voracious of the series; and the spineless rays, as, for instance, the common skate (*raia batis*), the least voracious, and the most localised. They are all, however, rather voracious, and they are active and powerful fishes.

The genus to which the angel-fish belongs gets the name of *squatina*, because the body is in all the species flattened or depressed, though not so much so as in the rays, but much more so than in the true sharks, with which this species used, very improperly, to be associated; but the body is not nearly so much depressed as in the rays, and the pectoral fins, though large, do not pass insensibly into the body, and appear to form part of it, as in those. The tail also is not nearly so slender as in the rays; and the whole outline of the fish can be distinctly traced, the large pectoral fins having something the appearance of wings, but still bearing the character of distinct appendages. It is from this wing-like, or tunic-like form of the fins, that the fish gets the names of angel and monk, for otherwise there is nothing either very angelic or very monastic in its appearance or its habits.

The mouth opens at the end of the muzzle, and not below, as in the sharks, and, generally speaking, in the rays. The teeth are formidable; they are broad at the base and narrowed to the points, so that they pierce and cut like broad arrows, and they admit of a lateral or sawing motion upon their articulations; but they are not quite so ragged and formidable as those of the sharks. The eyes are placed in the upper part of the head, whereas those of the sharks are placed laterally. The pectoral fins, as has been hinted, are very large, and they are armed with small spines on their margins. They stand forward at the front edges, something like the wings of a dragon-fly, only they are broader in proportion. Their front edges are closely united to the body, but their posterior ones are separated by a sort of slit. They have two dorsal fins; and the ventral fins are abdominal, or placed behind the last dorsal. There is no anal fin, and the caudal is placed equally upon the upper and under side of the termination of the vertebræ. The skin is rough and granulated, ash-coloured on the back, having a row of osseous plates with sharp points along the ridge, and white on the under part.

It often attains the length of eight feet, and is withal a most formidable fish, and dangerous to be approached when taken alive, as it not only bites desperately, but tears and lacerates with the spines on its pectorals and the points on the ridge of its back. It is not uncommon in the British seas, especially the Atlantic and the parts contiguous to it, but it keeps near the bottom, and thus it is not often seen in proportion to its numbers. The sole and flounder banks are its favourite haunts, and it captures vast numbers of those fish. There is, however, no danger of its exterminating them, for they breed so much faster, that a brood of flounders can support a brood of angel-fish, and yet have abundance for a succession. Like the sharks and rays, the angel-fishes are ovo-viviparous, or perhaps almost viviparous, though these are points difficult to be ascertained; and fishes which are either one or the other are never so prolific as the oviparous fishes.

ANGELICA (Linnæus). A large herbaceous plant cultivated in gardens, a native of Britain. Linnæan class and order, *Pentandria Digynia*. Natural order, *Umbelliferæ*. Generic character: no universal involucrum; fruit somewhat flat, margin winged, three acute costæ on the back, furrowed below. Species, nine; biennials and perennials. In a wild state angelica is unpalatable, and even dangerous as a salad herb; when cultivated it is increased in bulk, and loses its harshness of both fibre and flavour, partaking of that of celery, chervil, and parsley.

Cultivation. Sow the seed in March, and when the seedlings are three inches high, transplant them on a shady border three feet apart, there to remain. As it is a large rambling plant, it may be planted in any open part of a shrubbery. Being a biennial, annual sowings are necessary. The confectioner makes an elegant sweetmeat of the leaf-stalks.

ANGOPHORA (Cavanilles). A genus of two species of greenhouse shrubs introduced from New Holland. Linnæan class and order, *Icosandria Di-Pentagynia*. Natural order, *Myrtaceæ*. Generic character: calyx turbinated, five-ribbed, and five-toothed; corolla five-petaled, inserted in the calyx; stamens numerous, inserted in the throat of the calyx; filaments awl-shaped; anthers somewhat round; style like a thread; capsule three-celled, three-valved, three-seeded; seeds roundish, plane on one side, convex on the other, appended by their back; seed-leaves roundly foliaceous. These plants resemble metrosideros, and are esteemed ornamental.

ANGRÆCUM (Thouars). A small family of hothouse perennials belonging to the orches tribe. Linnæan class and order, *Gynandria Diandria*. Natural order, *Orchideæ*. Generic character: perianthium, somewhat resupinate; three upper petals like a helmet; labellum sitting, jointed with the column, often united; columna without wings, curved, produced above the anthers; pollen united in a glandular mass. All of this curious tribe of plants are interesting, but difficult of culture.

ANGUILLA (Eel). A genus of soft-finned fishes, without ventral fins, belonging to the family *Anguillidæ*, and form the leading or typical genus of that family. Every one is so familiar with the general form and appearance of eels, that they need no description; but many of their habits are so singular, they are so valuable in an economical point of view, and, now their physiology is a little better understood, the fresh-water ones, at least, may be rendered so much more valuable by culture, that they demand more particular explanation than could well be given in a general article upon a genus the species of which are so numerous. [See Eel, for the popular history of the eel, properly so called; and Anguillidæ, for the names of the several genera of eel-shaped fishes, under which their generic character and particular history, where necessary, will be found.]

ANGUILLARIA (R. Brown). A genus of three species of herbaceous perennials, chiefly from New South Wales. Linnæan class and order, *Hexandria Trigynia*. Natural order, *Melanthaceæ*. Generic character: calyx six-petaled, spreading star-like, regular; stamens inserted in the bottom of the petals; anthers burst at the back; styles three; capsule three-celled, three-valved; seeds numerous, roundish.

ANGUILLIDÆ. Eel-shaped fishes, which are arranged into the following divisions, or genera: *Anguilla, Aphisnous, Murænaphis, Sphagobranchus, Monapterus, Unibranch-apterus, Alabes, Aschioquathus, Gymnotus, Gyannarchus, Aphidium,* and *Ammodytes*, which see.

ANGUIS (snake). A genus of *Ophidian reptiles*, or "serpents," but differing in much of their structure and most of their characters from the true serpents; so much as to form a sort of link between them and the most simple of the saurian reptiles, or reptiles with produced tails and feet.

The animals which are included in the genus *Anguis* are among the most harmless, inoffensive, gentle, and retiring on the face of the earth; more so than almost any of those which the most refined and amiable of the human race cherish with the fondest affection, and caress to the display of an excessive and not unfrequently ludicrous degree of affection. To such, the gentle snakes are objects of aversion and horror, and they seem to have a "Cain's mark" set on them; for, even where the parties would be a little squeamish in the case of other creatures really noxious, "whoso findeth 'the poor snakes,' slays them," without mercy, and even with exultation.

This is one of those evils which can be removed only by a more general diffusion of the knowledge of natural history; and leaving the gratuitous murder of the poor snakes, and the mischief done by the prey which it is their province in nature to keep within due bounds, out of the question, the evil is really a serious one; and many a human being has suffered more mental agony at the sight of a little creature which could not have killed a kitten, than if about to be pierced by the fangs of the bushmaster, or crushed in the folds of the boa constrictor. All this, too, has been again and again suffered, simply because the snake has, in so far, the form of a serpent, and because there is a prejudice against the whole race.

Thus it is very important to understand the nature of the snake; and the more so, that it is common in many parts of Britain, and apt to be mistaken for the poisonous viper, which is not so common, and the venom of which is rendered far more virulent than it otherwise would be, by the fears of the parties that happen to get bit: for even the viper never bites man, or any large animal, if it can help it.

There are several species, or rather genera, of harmless snakes, that is, of snakes with neither crush nor poison, varying from the common blind worm of Britain (*Anguis fragilis*) to the *Acontias* of warmer climates; but they are all equally harmless.

The external characters are, the scales on the back and belly alike in size, whereas the true serpents have those on the belly larger and free at their posterior edges. Their large scales, or *scutæ* (shields), are, in fact, the substitutes for feet in the true serpents. [See OPHIDIA]. The upper jaw-bones are articulated immediately to the skull and the intermaxillary bones, so that on opening the mouth, the animals cannot raise the upper jaw; and the lower jaw is so articulated to the ossa quadrata, that they can depress it only a little way; their gape is in consequence very narrow, and does not extend far backward. Their eyes are very small, and furnished with a third eye-lid. Their motion is not the motion of a serpent, but that which we might imagine to be resorted to by an animal with a flexible backbone, if deprived of its feet. They advance by steps which consist of alternate straightenings and archings, the forepart of the body being advanced during the first, and the hind part brought up during the second. Their movement is thus a sort of gallop; but it is a singular one, being made without external legs.

The internal structure corresponds: there are shoulder bones and clavicles under the skin; and the rudiments of a breast bone, and the bones of a pelvis resembling that to which the posterior extremities of footed animals are articulated. These characters are most distinct in the blind worm; they gradually become less and less so in the others, and are almost entirely obliterated in the acontias, which have some resemblance to the more harmless of the true serpents, the first of which is the amphisbæna, which is as gentle a creature as the acontias; but even the amphisbæna has no vestige of shoulder bones, sternum, or pelvis, and no third eye-lid; but, like the true snakes, it can move both ways, which the serpents cannot do.

When the blind worm moves fast, its muscles are in so rigid action, that it may be broken in pieces by a slight tap with a small switch. It is for this reason that it is called *fragilis*, "easily broken." The others are less and less fragile as they depart from it in structure; but none of them can bear a severe blow, especially if hit when in the form of a bow.

In Britain, the blind worm is but small of size, seldom more than a foot in length, and never more than eighteen inches. The upper part is greyish, with two brown stripes down the back, and one on each side, from the eye backwards. The head is small, the neck slender, the body rather thicker, and continuing nearly the same to the tail, the tip of which is blunt. There are four rows of scales on the head; first one, then two, three, and four, in succession. It has small recurved teeth in each jaw. The scales on the neck are very small and imbricated. It lives in holes in woods, among heaps of rubbish; feeds upon very small animals; lies dormant in the winter. It is ovo-viviparous, or hatches its eggs internally.

The above described is the only species of the genus *Anguis* found in Britain. The other harmless species, which is more common, and grows to a larger size, is the "ringed snake," *natrix torquata*. The latter consists of a yellow spot and a black one on each side of the neck. The colour above is brown, with two rows of black spots, and irregular bands of the same across; and the under part dusky, with a black tinge. The head is flattened, the muzzle round; four rows of scales on the head, first two, then two, three, and two again toward the neck. It is oviparous. It frequents marshy places, and feeds on insects, frogs, and mice. It is mild and gentle in its disposition, and easily tamed. The *viper*, the only poisonous one in Britain, is rather smaller, and found in dry heathy places. Its head is broad behind, and has large scales on the edges of the jaws. It is black between the eyes, and has two black spots on the crown. There are three rows of spots on the body, one down the back of four-cornered ones, and one down each side of three-cornered. The ground colours of the body are apt to vary; but they are generally yellowish on the upper part, and dusky blue on the other. In all the varieties of colour, the three rows of spots distinguish it, unless when the upper part is black, and that is a distinction, as the harmless snake is never darker than brown. It also has always bands of dark spots across, while the other has none.

ANIMALCULE is literally the diminutive of the word animal, and as such signifies "a little living creature," a sense which is abundantly vague; but its application is restricted to an exceedingly numerous class of animals, which are, generally speaking, invisible to the naked eye, forming, as it were, a new world, which has been revealed to human knowledge by the microscope, and to which there appears to be no limit, save in the powers of that instrument. As these minute creatures are found only in liquids, in which vegetable or animal matters have been partially dissolved by infusion, they are sometimes called *Infusoria*; but the term is apt to mislead, as an infusion can no more of itself produce an animalcule, than the water can of itself produce a fish, or the air a bird, or than a house can produce a human being. The infusion favours their development, just as the development of larger animals is favoured by certain states of the weather and other circumstances; but the analogy of all nature demands that the germ of the animalcule should be there as well as that of the elephant or the whale, otherwise it would be as vain to look for the small animal as the large one. This fundamental principle we must carry along with us in every case of organised being, even though the details of the organisation be too minute for our perception, and the fact of its existence more an inference from the function than a direct result of observation.

And, upon this microscopic confine of our knowledge it behoves us to be very circumspect, inasmuch as the animal function is often as obscure as the organisation; so that it is only with the best instruments, the most careful and patient observation, and minds totally divested of all theory, or preconceived nature of what we are to find, that we can arrive at the truth. The grand law as to function is that inorganic matter obeys only certain attractions and repulsions, while that which is organised obeys new laws in opposition to these. Under a powerful microscope, however, there is always doubt, unless we can discern both organisation and function; and therefore this is not a department in which ordinary popular observation can well extend the bounds of knowledge.

But it does not thence follow that the subject is not one of popular *use*, for many of the most valuable parts of our knowledge, can be extended in themselves and their connexion with each other only by the few who are content to forego the common pursuits and pleasures of life, and toil and study without associate and without sympathy, supported by the sure hope that that which they are sowing in silence and secret will grow up and enrich the world with its fruits.

In this way, microscopic labours in natural history, and especially in the natural history of animalcules, are of very great importance in a popular and practical sense. They show us that, if we follow it in the direction of the minute, there is just as little limit to nature as when, by the aid of the telescope, we follow it to the vast. When we think of the myriads of stars, myriad behind myriad deepening into space, which a powerful telescope discloses in a very small portion of the heavens; when we consider that all these are certainly further apart from each other, and the nearest more distant from us than the swiftest-winged bird could fly in ten thousand years; that each of them is, by the most rational analogy, a sun surrounded by many worlds, all peopled with growth and life; that what the telescope thus reveals, is limited by the imperfection of that instrument, so as only to constitute the mere beginning; and that, though we could reach the most distant of those stars as easily in the body as we can in thought, we should not perceptibly change our place in the universe:—when we think in this manner, we feel what a wonderful thing creation is, and how unspeakably beneficent it is in the great Creator of all things to give such a system for our contemplation, and according to our knowledge for our use.

But even this view, grand and sublime as it is, is not complete, until we take hold of the microscope, and view the series the other way. Then we discover that the little globule of water that we can lift on a pin's-point is a miniature of this giant universe, instinct with living creatures which no arithmetic can count; and that in them, organisation and life are, according to their species, as perfect as they are in the largest animals which walk the earth or sport in the waters; that the fluids of plants and animals are full of life and its germs; and that the eye cannot so divide space, even by the aid of the instrument, as to enable us to say of the smallest sensible portion, "there is no living creature contained here." But here again we are limited by the imperfection of the instrument, and know not how much may lie between what has been discovered and the final bourn, at which organic life touches on the elementary particle. And when we glance our thoughts along this wonderful series, the first thing that strikes us is, that it is all equally perfect. Their functions are as varied as their forms and magnitudes; but when we compare each with the circumstances in which it is placed, we cannot say that one is relatively stronger or weaker than another: the animalcule in its drop of water is just as much "adapted and at home" as the elephant in the jungle, or the sun careering through measureless distance with all the planets in his train.

And it is further worthy of remark, that the law of life from the whale to the animalcule is one law. This unity and uniformity are established by the study of this branch of the animal kingdom. They, like the larger animals, have their different degrees of organisation; and, in conformity with what was said of these in the introduction to this work, the simpler the organisation the more retentive are they of life. Besides, in all cases where it is discernible, the germ can endure more than the developed animalcule, and there may be an initiatory point in its living in which it is proof against all destroying causes.

Some of the species of more simple organisation can bear to be boiled in close vessels, and others can bear a greater degree of cold than that at which water freezes. In general, however, the freezing of the water kills them; and some of those of the more complicated organisations cannot bear a temperature so high as that of the human body in ordinary health. In the case of freezing and thawing, it is not always easily ascertained whether it is the animals themselves which are resuscitated, or merely the eggs or other germs preserved and brought to maturity.

As those creatures appear in every liquid and infusion which is adapted for them, if freely exposed to the air, the origin of the germs has been a matter of curious inquiry; but if we compare the size of the eggs in the roe of a fish, when they are shed, and consequently matured, with the size of the fish when full grown, and apply the analogy, with every allowance, to the animalcules, we shall find that, until some microscope of much greater power shall be invented, it will be in vain to attempt to find their minute rudiments. In a fish which attains the weight of 25 pounds, the egg does not weigh more than 1-100th part of a grain, or, in round numbers the fish may be 175,000 times the weight of the egg in the roe. The cube root of that, in the proportional dimensions in line is, making allowance for the more regular shape of the germ, about 1-60th of that animal. Now many of the common animalcules require a magnifying power of 500, and some of them of 800 in line, before they are distinctly visible; and, supposing the germ to be in proportion as above stated, it could not be seen without a power in line of 30,000, which, according to the usual estimate, would require a focal length of only 1-300th of an inch, an instrument which could not be constructed upon any principle at present known in the arts. It may be proper to mention that the magnifying power, in surface, is 900,000,000! or one which, if it could be applied, would make the floor of Westminster Hall appear as large as all England.

But minute as those germs must be, and vain as is the hope of finding them in their rudimental state, they are as much within the action of the common laws of nature as those of the largest animals. The action of the air is necessary for their development. The experiment of Spallanzani is conclusive upon this point, though it does not warrant the conclusion which he draws that the germs necessarily descend from the air. They are indeed so very minute that it is impossible to imagine an atmosphere so still as not to move them about, and difficult to imagine a place where they cannot find entrance. Spallanzani's experimental vessels contained infusions which had been boiled for an hour. Some of them were left open, others closed with cotton wool, a third set had wooden stoppers, and the fourth were hermetically sealed. At the end of twenty-five days there were animalcules in them all; very abundant in the open ones, and less and less so in the others, till in the sealed vessels they were very few. A film of oil on the surface of the infusion had nearly the same effect, and apparently from the same cause, that of preventing the action of the air.

It is by no means impossible that the germs of animalcules may ascend with water in the process of evaporation, and descend again with the rain; and it may be also that they are carried by the water into the earth, and flow out again into the most pure and limpid springs; but the developed animals are very rare in water in its pure state, so that, as is the case with the spawn of fishes, the eggs of insects, and the seeds of plants (with all known germs of living creatures indeed), a specific elementary action is necessary for their development.

That action appears to be heat and humidity jointly, and the heat appears to be in part derived from the putrid fermentation; as they are not only brought forward by artificial infusions, but appear in all shallow waters where vegetable matter is in a state of decomposition; and as they are found in vinegar and in sea-water, they can at least endure the acid and salt which are in these. That they can exist in pure vinegar, or vinegar in which there is no vegetable mucilage, is not probable; and they are prevented from being developed by a small admixture of sulphuric acid with common vinegar, which hinders the formation of "mildew" as it is called by dealers. From the observations and experiments of Dr. Power, it appears that these inhabitants of vinegar (*vibrio aceti*) have some peculiarities of character. If the temperature is raised a little above that of the human body in a state of health, they die; but they can bear to be frozen in the vinegar and again thawed out of it. They do not, however, bear this intense cold patiently or willingly, for they escape if they can, even into a substance in which they are not naturally produced.

The structure and functions of animals so very minute cannot, of course, be well understood; but still enough has been gleaned, partly from one partly from another, for enabling at least a rational guess to be formed. They all have a mouth and stomach, of some form or other; and some of them are as ravenously carnivorous, and eat up their brethren with as much avidity and gusto, as the most voracious fishes. Some of them are *polygastric*, or have many stomachs, in the form of little sacs united by tubular connexions; and others are *monogastric*, or one-stomached, and have generally alimentary canals. Of course nothing is known of the nervous or circulating systems of animals so minute; and the existence of these is inferred rather than proved. Some are furnished with eyes; and all have some means of perception by which, to a certain extent at least, they keep themselves out of danger. Muscles, and other organs of a considerable degree of complication, have been distinctly observed in several of the larger ones; and as they are all locomotive, and some have the power of attaching themselves to other bodies by means of little hooks or otherwise, and all of them can partially alter their shape, it is probable that the whole have muscular systems more or less complicated in proportion to their functions. Some of these muscles must be exceedingly minute, not the ten-thousandth part of an inch in length, or the millionth in thickness; and yet they are probably made up of fasciculi containing as many fibres and contracting on the very same principle as those of the largest animals. It does not appear that any of them have internal bones; but they seem all to be invested with an integument sufficiently tough for allowing of insertion of the muscles; and some are covered with shells which, in some of the species, are regular bivalves, and when the valves are shut enclose the whole body.

Some are coloured, but the greater part are nearly colourless, and some are quite transparent, so that they are seen by the refraction and reflection of light at their surfaces; and it affords a wonderful proof of the delicacy and divisibility of light, when we consider that it can be differently acted on by the several parts of the bodies of creatures of which the whole mass is so small.

Their modes of reproduction are not the least curious part of their economy; and in these, as in some other matters, the different species resemble more than one class of the larger invertebrated animals. Some propagate by spontaneous division;

and that division takes place in many ways, so that the new animals might be often taken for different species. Some are gemmiparous upon peduncles; some are oviparous, some ovo-viviparous, and probably some are simply viviparous. It is not known whether the mode is uniform in the same species; but the probability is that it is not always so, but that some increase both by germs and by teguments; and that, as is the case with some of the small invertebrated animals which are visible to the naked eye, their modes of reproduction are different at different seasons.

The natural periods of their duration are not known; neither are their seasonal appearances. It is in the temperate climates chiefly that they have been examined; and in these they are mostly summer animals, but appearing at greater differences of period than the larger seasonal ones. A portion of water in the sun and another in the shade appear to be the West Indies and Melville Island to the animalcules, though probably the germs of them may be equally numerous in both. When the limna on the surfaces, and the confervæ and other small plants at the bottoms of the shallow waters have arrived at maturity and begin to decay is the time when these creatures are most abundant; but which of them perish, and which hybernate after the cold weather sets in, has not been ascertained.

There is one curious fact in these occurrences; and that is, the power which many of the species have of being revived again, not from a state of torpor merely, but from one of perfect dryness, in which they are not to be distinguished from small and light particles of microscopic mould. Analogy would lead us to suppose, or rather we are certain, that the apparent dead state of the animalcules cannot be real and absolute death, because from that there can be no return of the individual but by an effort of creative power, and none of the matter composing the individual but by the assimilating powers of another living creature; but still it should seem that all the functions of life are totally suspended, and can so remain for a considerable length of time. One of those in which the process of being dried and again reviving has been most observed is the common wheel animalcule, *vorticella rotatoria*, which is very curious in its form and motions, and has the advantage of being visible to a good eye without the microscope.

While it has sufficient water, at a temperature not exceeding about 110 degrees of the common thermometer, it is a very active creature; but when the water is nearly exhausted by evaporation it becomes languid, the motion of the wheels is suspended, they are withdrawn and disappear; the animal shrivels, becomes hard, and if touched with the point of a fine needle, it bursts in pieces, as if it were a little tear of unannealed glass. One would imagine that there could be no signs of death more unequivocal than these; and when the animal is blown to powder by being touched with the hard point, there is no question of the fact. But it is not only not dead, but if sharp points are kept away from it (the action of which, though most curious, is inexplicable upon any known principle), it is more difficult to kill than when it has the use of all its members. They bear a considerably higher temperature if perfectly dry; but if moisture is applied with the increase of temperature, the animal is instantly killed. If kept dry, and the heat not excessive, it can be kept for weeks, months, and even years, indeed for any indefinite time; and all that it requires to restore it again to the world of animation is simply moistening it with water.

The return of the animal to activity, as observed by Leeuwenhoeck, whose observations have not been surpassed for accuracy, is curious. Some revive in a few minutes, others not till after several hours; and this difference in the time of resuscitation appears to have nothing to do with the period during which the creatures have lain dormant. The animal first enlarges in size, then it begins to move and elongate at the head and the tail, after this the wheels expand and begin to move, and the animal is soon as brisk as ever. Nor is it only once that this death and resurrection (so to speak) can be made to take place in the same individual. Spallanzani revived the same ones several times over, though with a diminution of their numbers each time; and at the sixteenth attempt none of them revived. It should seem, both from this and from the different times which they take in reviving, that they are not all equally strong; but what are the differences of age or other circumstances upon which the powers of endurance depend, is not known.

The fact is a most singular one in physiology; and as we cannot suppose that they have this property only to be developed by experiment, we must conclude that they are subject to these temporary deaths and resuscitations in a state of nature; but from their small size we can observe them only experimentally. Their breathing apparatus must be different from every species of gills with which we are acquainted in any larger animals which breathe in the water; because all these, so far as is known, perish beyond the possibility of resuscitation as soon as their gills become dry. That they do breathe to some extent is certain, because they can neither be produced nor live in vacuo; and when cut off from a supply of air they perish before the water is evaporated, nor does it appear that, in any case, they revive again after they have once ceased to perform their functions in a humid state.

Whether they are the only animals that can be seasonally preserved by perfect desiccation, and again revived by moisture, is a question which it would be desirable to solve, as connected with the seasonal history of other aquatic animals of those countries where the grand alternations of the year are wet and drought; and one would be almost tempted by analogy to conclude that some of the leeches which infest the earth of Asia (in particular) almost the instant that the rains set in, and before we can reasonably suppose that they have grown from the egg, or other germ, must pass the dry season in a similar state. We know that many of the plants of those countries which die down into their tubers, pass the season of drought with the greater safety, and grow the more vigorously, the more completely that they are dried while the drought lasts. So well is this understood that, in many of our cultivated plants (and the greater part of them are natives of warm climates), we preserve their floral beauty and their culinary usefulness by taking up and drying the roots during the season of vegetable inaction. Other occasions will, however, afford us a more complete investigation of this curious and interesting subject; but as the animalculi are miniatures of animals, and make their appearance in that portion of our year in which the alternate dry heats and showers form a sort of miniature of the tropical year, the study of them leads very naturally to that of analogous animals and seasons upon the grander scale. It is one of the great points of superiority in natural history over all other studies, that there is no part of it but which, when properly followed up, guides us to the rest.

The details of animalcular history are somewhat nice and difficult, because of the fine instruments and minute observation which they require; but even here human ingenuity has been able to accomplish a good deal. At first it would seem that nothing could be known of the *internal* structure of creatures invisible to the naked eye, and in general perfectly transparent and colourless in all their parts; but by means of infusions of the colouring matter of vegetables or animal colours, first made use of by Baron Gleichen, the alimentary structures of many have been made out; and, partly by being seen against the vessels filled with the coloured infusions, and partly by other means, muscular tissues have been traced. Indigo, sap-green, and carmine have been found to be the colours best adapted for this purpose, and that they should tinge the vessels of these minute creatures to their most delicate ramifications shows how fine the division of the colours must be.

The indigo and sap-green are direct vegetable substances; and we need not wonder why the animalcules swallow them with avidity, because putrid vegetable matter is both the nidus in which they are brought to maturity, and their food during life. But that species which breed and feed on vegetable infusions only, and which we have every reason to conclude are generically or, at all events, specifically different from those that are bred in animal matter, should feed on carmine, which is usually regarded as an animal substance, is a different matter, and throws a sort of new light upon the nature of carmine, or rather of cochineal, of which carmine is a preparation. Cochineal is obtained from the *coccus cacti*, and from that insect in substance; but still the most rational view of the matter (and it is much strengthened by this fact of the animalculi swallowing it with avidity) is that the colouring matter of cochineal is, like wax and lac, a vegetable substance, absorbed by the insect, and retained for a particular purpose, but not assimilated or animalised.

The result of those observations has been a sort of double means of arrangement in the animalcular province; those that have one stomach and an intestinal canal, and those which have many insular stomachs: first, according to internal structure; and secondly, from the external structure; those which have appendages to the body, and those which have none. There is still a third means of classification; those which have the body covered with a simple integument, and those which have it covered with a shell, or second coat of some description or other; the first of these are called *nuda* (naked), and the second *loricata* (clad in armour).

The first and second of these means of classification harmonise tolerably well, so as to admit of a division of the greater number into two classes: *polygastrica*, or many-stomached; and *rotatoria*, or those which have appendages that seem to revolve. These last are curious instruments, and differ from those of all the larger animals, except that there is, perhaps, a slight resemblance to them in the spines of the *echinæ*, or sea-hogs. These are often placed in the circumference of a circle; and as each of them has a rotatory motion on its base while at an angle, and thus describes a little circle with its base points, the whole circle appears to revolve round like a wheel, very rapidly, as the apparent revolution of the whole takes place in the same time as the real rotation of a single one. See POLYGASTRICA, ROTATORIA, and VIBRIO, for the details.

ANISANTHUS. A family of Cape bulbs, usually grown in a frame or greenhouse. Linnæan class and order, *Triandria monogynia.* Natural order, *Irideæ.* These beautiful plants were formerly ranked with their near neighbours the antholyzas and gladiolus, but separated by Mr. Sweet. Their culture is similar to that of other Cape bulbs of the same character, viz. keeping them in a frame, either with or without pots, of peat-earth and sand.

ANISE. The *Tragium anisum* of Linnæus, placed by him in the second order of his fifth class, viz. *Pentandria Digynia.* Natural order, *Umbelliferæ.* Generic character: involucrum neutral; fruit, oblongly egg-shaped, downy, raphe smooth. This is a highly aromatic herb, and in former times was much prized as a condiment in food, either used green, with other herbs, or the seeds alone. As a salad or pot-herb it is now but in little requet, its seeds only being used by the confectioner and druggist.

It is cultivated on light finely prepared ground in an open situation; the seed is sown pretty thickly, either in drills a foot apart, or broad-cast on a border about the middle of April. During growth the crop is kept free from weeds, and the seeds are gathered when ripe.

Aniseed tree.

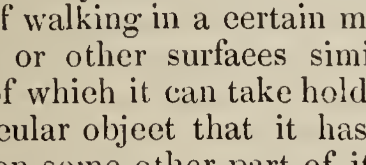
ANISEED TREE, of which the above is a figure, called by Linnæus *Illicium anisatum*, from its scent being like that of aniseed. Class and order, *Polyandria Polygynia.* Natural order, *Magnoliaceæ.* Generic character: calyx three-sexpetaled, deciduous; sepals unequal; corolla nine or more petals, unequal; stamina, inserted on the receptacle; filaments very short; anthers erect, oblong, emarginated; style very short, stigmata lateral, oblong; capsules several, disposed in a circle, ligneous or leathery, opening at the top, one-seeded; seed hard and albuminous.

This is a very beautiful, highly aromatic plant. The flowers are dark purple, and hang from the branches by slender footstalks. The ripe capsules are used in China as a spice, and sold under the name of "five-fingers." It flowers readily in our stoves, and is propagated by cuttings.

ANISODACTYLI ("Unequal-toed" birds). A peculiar order of birds, most of them of small size, and some the most minute of the feathered tribes, being less in dimensions and weight than many of the insects, but still preserving all the characters of birds in their parts, plumage, and modes of life, and often displaying the warmest floral colours, and the richest metallic reflections, which are any where to be met with among the productions of nature.

They are all bark, or at least tree, birds, and most of them feed upon insects, though some are understood to feed upon the honey of flowers. Some are continually running in all directions along the boles and branches of trees, and others are much upon the wing.

The character upon which the order is formed, is that of having the outer toe united to the middle one at the base; the other two free; the hind one strong, and capable of being bent a little inward, while the outer front one can be partially reversed. All the toes have the claws strong, sharp, and considerably hooked, and the peculiar articulation enables the bird to grasp with the foot in all directions, in the line of the body, across that line, or at any angle to it, so that whenever the bark of a tree will allow of the insertion of the points of the claws, the birds can run upwards, downwards, or round the bole; and those which feed chiefly on the trees generally have the tail so stiff, and so capable of muscular action, that they make use of it as a strut, by which means the weight of the body makes the claws keep a firmer hold. The following figure of the foot of the common nuthatch will show the structure of the anisodactylic foot:—



Foot of Nuthatch.

As this order is founded upon the structure of a single organ only—the foot, it cannot be regarded as a natural one for any very general purpose of utility. All that it positively shows is, that the bird which has it is capable of walking in a certain manner upon the bark of trees, or other surfaces similar in position and posture, of which it can take hold with its claws; but the particular object that it has in so walking must depend on some other part of its organisation; as, for instance, on the food which its bill can take and its stomach digest. For that reason it is not necessary to refer from this order to the groups and genera.

ANISOMELES (R. Brown). A genus of undershrubs, natives of India and New Holland. Linnæan class and order, *Didynamia Gymnosperma*. Natural order, *Labiatæ*. Generic character: calyx, a swollen tube, with ten ridges, and five-toothed; corolla, upper lip small, whole; the lower three-lobed, the middle one margined; stamens with short two-celled anthers, unequal in length; caryopses smooth.

ANISOPETALUM (Hooker). A genus of one species, introduced from Nepaul. *Gynandria Monandria* (Linnæus). Natural order, *Orchideæ*. This plant, like all the natural order to which it belongs, is curious in habit and manner of flowering. Its name is commemorative of Dr. Carey (*A. Careyanum*), a friend of Dr. Hooker's.

ANISOTOMIDÆ. A family of insects, belonging to the order *Coleoptera*, consisting of six genera, several of which contain a considerable number of species. In this family the antennæ are generally moniliform, or bead-shaped, somewhat elongate, and rather slender at the base, gradually increasing towards the apex, the terminal joint being of an elongate club-shape varying in the number of its articulations; palpi various, generally filiform, the head small and ovate, the body being mostly convex, but never linear; the tibiæ in some of the genera compressed; the tarsi various, the four anterior ones being five-jointed, and the posterior ones four-jointed. In the

A. Tritoma, (Fabricius), the maxillary palpi have the last joint large, transverse, and compressed; maxillæ with a minute tooth at the apex; antennæ short, of an ovate three-jointed club-shape, having the head somewhat triangular, the thorax being elevated in the middle behind; the legs moderate; the tibiæ compressed; of a broad, elongate, triangular shape. Of this genus only one species has yet been found in this country. It is found in fungi in the spring months, and is described by most writers under the name of bipustulatum. It is also figured in Samouelle's Entomologist's Compendium.

A. Phalacrus (Lati). In this genus the palpi are filiform; maxillary with the terminal joint elongate; labial very short; maxillæ with the apex strongly bidentate, or double-toothed; antennæ rather slender, distant at the base, a little elongate; the capitulum oblong; the terminal joint ovato-conic; head small, triangular; thorax gibbous, with the hinder angles ovate; body hemispheric-ovate, or oval; elytra entire; legs short, compressed; tibiæ short, straight, not spinous; tarsi slender; the penultimate joint cleft.

Stephens, in his British Entomology, describes twenty-eight species of this genus.

The Phalacri are usually rather brilliant insects, and are very frequently adorned with metallic colours. Unlike the other genera of this family, their body is generally very convex, and incapable of being contracted into a ball, as in Agathidium; the club of the antennæ is three-jointed, and the penultimate joint of the tarsi two lobed. The various species are mostly found in flowers.

A. Ephistemus (Stephens). This genus differs from the preceding by having the palpi stronger, the maxillary with the basal joint being rather robust, the terminal one elongate; labial very short; mandibles, rather prominent, with the apex entire; antennæ rather elongate, approximating at the base, the two basal joints robust, the third more slender than, but not so long as, the second; the five following very short, globose; the remainder forming a triarticulate club, with the terminal joint obtuse; head minute; thorax slightly gibbous, a little narrowed anteriorly; elytra entire, slightly attenuated behind, rounded at the apex; body elongate-ovate, and sharp pointed at each end, somewhat convex; legs short; tibiæ slender, not spinose; tarsi very slender, all five jointed, the penultimate joint simple. Only three species have yet been found, and they were detected in the environs of London.

A. Leiodes (Latreille). Palpi scarcely filiform; maxillary with the terminal joint nearly cylindrical and acuminate, the preceding minute labial rather shorter, with the apical joint nearly ovate; mandibles somewhat protruded, acute. Antennæ, with the three basal joints nearly cylindrical, the third rather the longest, the three following short, nearly globose, the remainder forming a five-jointed club, the second joint of which, or the eighth of the antennæ, is very minute, and the terminal, or eleventh, large and subovate; tibiæ compressed, externally spinose; posterior sometimes bent; tarsi, four anterior five-jointed, slightly dilated in the males, two posterior four-jointed.

This genus is rather an extensive one, but the species are far from abundant in Britain, only twenty-six species being described by Stephens. They differ considerably among themselves, but may be at once distinguished from the other genera of this family by the minute eighth joint of the antennæ, or the second of the capitulum. The species are found in Boleti, Agarici, beneath the bark of trees, putrid wood, damp banks, &c.

A. Agathidium (Illiger). In this genus the palpi are filiform; maxillary with the last joint conic; labial small; mandibles with the apex acute; antennæ short, with a subovate club; head rather large, inflexed; thorax with the angles rounded, large, the sides inflexed; body globose, hemispheric, capable of being contracted into a round ball; elytra entire, inflexed laterally; legs short.

The Agathidium resembles Leiodes in several respects, but may be readily known by the structure of the antennæ, the eighth joint not being smaller than the seventh, and the three last forming a subovate club, which, however, varies a little in the different species; and from the facility these insects possess of rolling themselves up into a ball when alarmed. They inhabit putrid wood and fungi, and may be occasionally found in sand and gravel pits, into which they fall by accident.

Twelve species are described by Stephens, most of which have been found near London.

Genus Clambus (Fischer). Trophi minute; antennæ as long as the thorax, slender, pilose, the two last joints large, oblong, forming a club; head large, nearly or quite as broad as the thorax, rounded anteriorly; thorax transverse, the lateral margins more or less attenuated; elytra very convex, and gibbous anteriorly, attenuated, and declining posteriorly, the apex rounded; body contractile into a ball; legs short; tibiæ slender, slightly pilose; tarsi obscurely articulated.

Like Agathidium, the species of this genus have the power of contracting themselves into a ball when alarmed. From the genus just mentioned they may be known by the great width and bulk of the head, and by the club of the antennæ being composed of two joints only, a structure which also obtains in the genus Orthoperus: but in that genus the head is small, the elytra but slightly gibbous, and somewhat truncate posteriorly. As in the kindred genera, the species are found beneath putrid leaves and wood, or in fungi, and in sand and gravel pits, &c. Owing to their extreme minuteness, and the want of specimens, we have not been able to detail their generic characters so completely as could be wished.

Genus Clypeaster (Andersch). Trophi very minute; antennæ rather slender, the three terminal joints forming an elongate ovate compressed club; head minute, concealed beneath the anterior margin of the thorax, which is produced and semicircular; the thorax itself semioval, pubescent; scutellum minute, rounded; elytra ovate, slightly convex, the apex obtusely rounded, pubescent; legs slender, the posterior pair remote from the intermediate; tarsi slender, four-jointed, posterior with the terminal joint very long and curved.

The minute head of the insects of this genus, which is concealed beneath the thoracic shield, distinguishes it from clambus, from which genus it also differs by its depressed body, triarticulate clava of the antennæ, and semi-oval thorax; from Sericoderus, which has also the capitulum tri-articulate, the rounded apex of the elytra removes it; and Orthoperus has the head minute, not concealed beneath the thorax, and a biarticulate capitulum. The only indigenous species is found beneath the bark of trees, &c. at Darenth Wood.

Genus Sericoderus (Stephens). Trophi very minute; antennæ rather elongate, slender, the three last joints forming an elongate capitulum; head small, concealed beneath the anterior margin of the thorax, which is slightly produced; thorax sericeous, broad, sub-triangular, the hinder angles somewhat acute; elytra sericeous, slightly gibbous anteriorly, a little depressed behind, the apex distinctly truncate; legs slender; tarsi obscurely articulated.

This genus is at once known from the rest of the family by its truncate elytra, combined with the tri-articulated capitulum of its antennæ, minute head, and projecting anterior margin of the thorax, exclusively of other characters.

ANNELLIDÆ (from *annellus*, a little ring). A class of invertebrated animals, and the first of the four into which the *articulata*, or jointed animals, are divided in Cuvier's *Animal Kingdom*. See Articulata. In common language they are known as worms, leeches, and other names, according to the species and the habit. The annellidæ must not be confounded with the *annulosa* of some systematists, which includes all the four orders of articulated animals, and is therefore synonymous with that term. Annulose means that the body of the animal, taken in the direction of its length, is divided into a certain number of rings, segments, or joints, of which the principal ones are the head, the breast, and the belly: the distribution could, however, be much better described upon other principles than that of being so divided into *annuli*, which, in very many instances, have little resemblance to rings, being generally different from each other on the upper and under sides of the body. The annellidæ are free from those objections. Their rings surround the body, they are very small, and proportionally numerous. They seem also, in all the known species, to be the only substitute which the animals have for a skeleton; and they are the chief, indeed the sole, organs of locomotion, either by their own edges, or by means of small but stiff bristles, with which many of the species are furnished, singly or in little tufts. The power of expansion or contraction which those rings possess is truly wonderful, as may be seen in the common earth-worm, the leech, and especially the horse-leech. In other countries there are species which have this property in a still greater degree. Those leeches which are so annoying in Ceylon, and some of the other Eastern countries, when the earth is moist, by fastening upon the legs in multitudes, and which are as difficult to be removed as mosquitoes, can draw their bodies out to as fine a staple as the hair of the human head, or even finer, and thus it is scarcely possible to exclude them from any place. When drawn to their utmost possible thinness, they retain their strength, and thus they glide away with wonderful velocity, so that one can scarcely discern the expansion and contraction of the rings. Those that have this power have no bristles, or other substitutes for feet, upon the rings; so that they are enabled to bring the whole of these into action in each progressive effort. Their means of holding on are two suckers, one placed at each extremity; the posterior one being fixed when the body attenuates and lengthens, in advance, and the anterior one when the body thickens and is drawn towards the head. Thus these animals proceed by a sort of steps, each as long as the distance to which the body stretches when attenuated; and performed by the two suckers something in the same manner as if these were two feet; only the rear foot never comes quite so far in advance as the front one. Those with bristles to the rings do not move so rapidly along, but crawl and wriggle, moving parts of the body in succession, and not using the whole of it for single majestic strides.

The Annellidæ are, by Cuvier, designated "red-blooded worms;" because their blood is generally of that colour; and, which is not a little singular, the flesh, if flesh it can be called, of some of the land ones, has, both in its recent and its putrid state, nearly the same smell as that of the mammalia. Their bodies are more or less elongated, and more or less capable of elongation when they walk; they are always divided into numerous small rings, of which the first is usually styled the head, and contains the mouth, and probably the organs of sense, but the latter are obscure in all the species, and in some they cannot be traced. The mouth, in some instances, consists of jaws more or less developed and strong, and sometimes of a simple tube. There are no visible nostrils or ears; and the dark spots, which in some are regarded as eyes, are very questionable, and they are wanting in very many of the species.

The circulating system is double, consisting of both arteries and veins, sometimes without anything that can be considered as a heart, and sometimes with several distinct fleshy ventricles. The organs of respiration differ much both in position and in structure. Sometimes they are situated in the posterior part of the body, sometimes externally on the sides, and sometimes in the interior of the body. Those which inhabit the land, or the earth rather (for they live under the surface rather than on it), have the breathing apparatus always internal; and it must be considered as lungs. Those which inhabit the water (and the majority of them live more in the mud and silt than in pure water), have the breathing apparatus sometimes internal, when the body is naked, and always external when they live in tubes. The tubes which they inhabit differ however from the shells of the mollusca, even when these are tubular in their form. The annellidæ secrete part of the tube in all cases, that is, the cementing matter by which the harder substances are held together; and when the harder matter is salts of lime, they probably secrete these also. But the tube forms no part of the animal, and is not in any way attached to it; it is merely a house or case which it inhabits, in so far defended from danger, and which it has the power of enlarging as necessity requires. In all those species which inhabit the water (and they are far more numerous than the land ones), the breathing apparatus is to be considered as gills; and those gills are often of very elegant structure.

The nervous system consists of a double longitudinal chord, united in two or more ganglions; but it is difficult to trace the minute ramifications of the nervous tissue, and still more, perhaps, to determine the number of senses or the organs in which the specific ones are allocated. It is certain, however, that many of these animals have extreme sensibility in some way or other; but whether that belongs to the whole surface of the body, or to any particular portions of that surface, has not been, and in all probability cannot be ascertained. The use of the common leech, in foretelling changes of the weather, long before these are cognisable by any of the human senses, or even by the generality of hygrometrical instruments, is well known; and the common earth-worm is also exceedingly sensitive; but whether its sensibility arises from the mere concussion of the earth, or the air acting upon its muscular and sentient system generally, or whether it is to be considered as a peculiar modification of the sense of hearing, has not been ascertained. In the reproductive system, the greater number, if not all the class, are true hermaphrodites, but not, in as far as is known at least, self-fertilising in any of the species. In many of them, however, the pairing is reciprocal, the young are brought forth alive, and undergo no metamorphosis.

Though the place which the annellidæ occupy in nature appears to be a humble one, they are by no means without their usefulness. The marine species, which are by far the most numerous, supply a large portion of the food of many of the shore and bank fishes; and they furnish the fisherman with one of his most easily-acquired and useful baits. Of the land species, the use on land is not so clearly seen, because they generally disfigure lawns and other portions of grass which mankind wish to keep neatly trimmed; and as their chief enemy under ground is the mole, he, in his hunting after them, disfigures the surface much more than they do. Still about the time when larks and various other species of ground birds begin to flock, the common earth-worms are much on the surface, and afford the birds an abundant supply of food, while the young of the worms come in time to supply largely the young of many birds. It is probably in the waters, however, that even the land species are of the greatest utility. When the meadows are flooded during the rains the worms are driven from their holes under ground, and carried down in vast numbers by the current of the water; and whenever that water stagnates, and especially where it forms eddies, they are deposited, and the fishes, trout especially, are on the *qui vive*, feast daintily, and become rich prizes for the angler. Nor is it to these alone that the annellidæ are highly useful. Many of the flat-billed birds, whether they dabble in the shallows, or dive where the water is a little deeper, subsist in great part upon the annellidæ; and the flesh of those that do so is far superior to that of the species which live chiefly upon fish. The annellidæ, in many of their characters, have a considerable resemblance to the mollusca; and it is worthy of remark, that birds or fishes, which feed upon the one or the other, are generally superior in flavour to those which feed on vertebrated animals, and especially to those which feed upon radiated animals, many of which are understood to give poisonous qualities to the fishes that feed upon them.

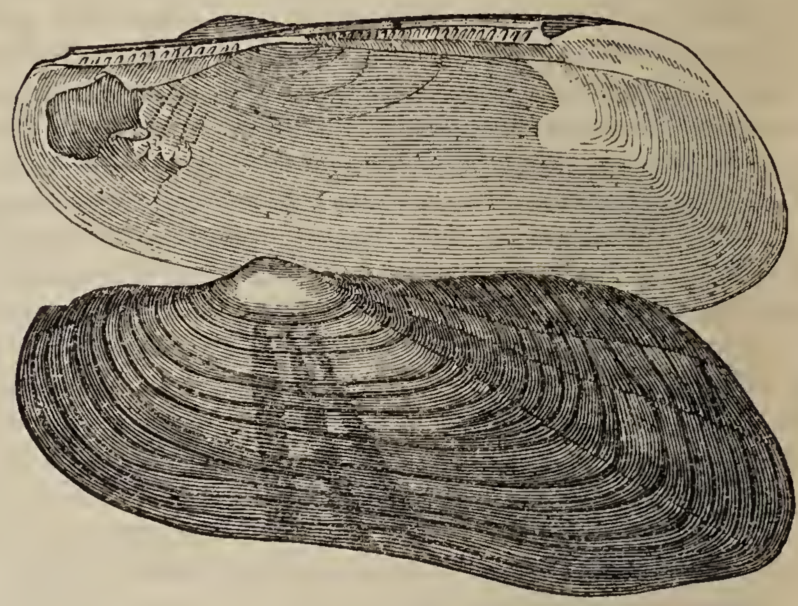
The annellidæ are, from the structure of their breathing apparatus, readily divisible into three orders, *Tubicola*, *Dorsibranchia*, and *Abranchia*.

Tubicola. These, as the name imports, inhabit tubes or pipes. Sometimes the tube is calcareous, of a structure tolerably uniform, though coarse and bearing some resemblance to the shells of mollusca; but in no case is it united to the body of the animal by any muscular or tendinous connexion. Tubes of this kind are generally understood to be formed of a sort of secretion or exudation, furnished by the body of the animal, but by what part of it has not been ascertained. The tubes of these often proceed by curious convolutions and ramifications along the surface of submarine stones; they are not found in fresh water. Other species unite together by a sort of cement, grains of sand, little pieces of mud, and portions of shells; and there are some which construct for themselves membranous tubes, formed entirely of flexible or horny substance, but their bodies are not more united to these, than when the tubes are chiefly composed of foreign substances. The animals of this order have the breathing apparatus in the form of small plumes of feathers, or minute branches of trees, exquisitely ramified, and attached to the head or to the anterior part of the body.

Dorsibranchia. These have the breathing apparatus spread over the surface of the body in the form of brooches, rings, scales, or tubercles. A small number of them live in tubes; but by far the greater part either live naked in the mud or swim freely in the water. All the species of the two orders now mentioned have their sides furnished with small bristles, stiff, and having a metallic lustre, sometimes single, and sometimes in little clusters or tufts; these bristles are to be considered as their organs of locomotion, whether along hard substances, through the ooze and mud, or through the water.

Abranchia. The animals of this order have not, as the name imports, any external organs of respiration that are apparent to common observation. Those which inhabit the earth, and of which the internal breathing apparatus must be considered as lungs, appear to breathe with the whole surface of the body, or at least by means of minute pores generally distributed over the surface. Those which inhabit the water and have the internal breathing apparatus, as gills, appear to breathe by receiving water into the internal cavities. This order admits of a very obvious division into two families: those which have the rings furnished with bristles, and those which have them without. Some of the first inhabit the land, and the most familiar type is the common earth-worm; and the others of that family mostly inhabit fresh water, and one species at least live in tubes. These move on by the action of their bristles; but they can move; for some distance at least, with either end foremost, as may be seen in the case of the common earth-worm, which, if it has the least bit of the tail in its hole, can speedily draw in the whole body. The common leech is an example of the second family, the members of which are chiefly aquatic: they move along solid surfaces by means of their suckers; and through the water by flexures of the body. See Lumbricus, Hirudo.

ANODONTA, *or more correctly* Anodon. (Lamarck); Mytilus, (Linnæus). A genus of molluscous animals belonging to the class *Acephalophora*; order *Lamellibranchiata*, and family *Submytilacea* of De Blainville's Malacology. The body of this shell is rather thick, slightly compressed, more or less oval; the mantle, with thick edges, plain or



Anodon Dipsas.

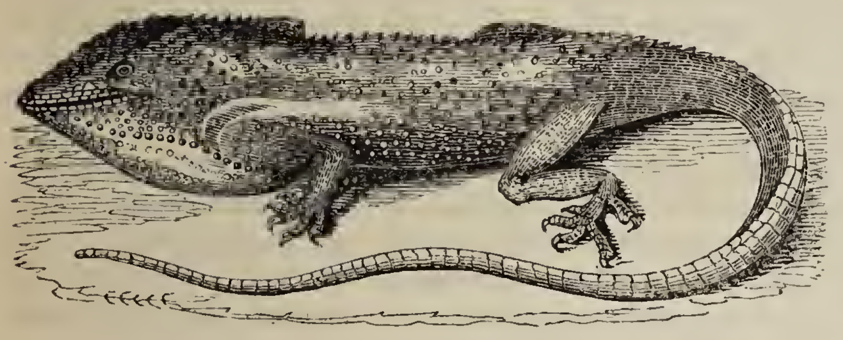
fringed, open the whole length of the circumference, except towards the back, a distinct oval orifice for the vent; a species of little tube, incomplete and fringed with two rows of rather long cirrhi, forming the respiratory cavity; the foot lamelliform and sharp. The shells of this genus have been separated from the Linnæan *Mytili*, with which however they are so nearly allied that it requires a careful examination of the hinge to distinguish them from each other; this genus, however, wants the cardinal and lateral teeth, and merely presents a smooth internal rim round the edge, whence it has very characteristically been named Anodon, from α, not, and ὀδοὺς, a tooth (having no tooth); this rim is terminated at the anterior end by a sinus or notch, in which the anterior extremity of the ligament is sunk or attached. This species of shells is usually eroded or rubbed by the frequent opening and shutting of the valves, which takes place while in the act of feeding or removing from one spot to another. The substance of the shell is pearly (*and some of the species produce pearls*); it is covered with a false epidermis; the valves are generally thin and concave, they occasionally attain a considerable size; the valves are similar in size, transverse, inequilateral, with two distinct internal muscular impressions, the ligament external, insinuated at the anterior extremity into the sinus of the cardinal ridge.

They inhabit ponds and lakes in every part of the globe, particularly in North America, and the animal is supposed to be viviparous; that is, to bring forth its young alive.

De Blainville divides this genus into five species: the first, such as are thin, oval, much elongated, not oared, the hinge very long, straight, and crenulated its whole length, as in the *Anodon exotica*, which forms Lamarck's genus *Iridina*; the second species are oval, with the hinge arched, and without any trace of ears, as in the *A. rubens*; the third species are oval or elongated, a linear hinge, and oar-shaped at the anterior only, as in *A. cygnea;* the fourth species is oval or rounded, auriculated at both ends, as in *A. trapezialis;* and the fifth is much more auriculated, with a lengthened blade, and much more salient at the hinge, as in *A. Dipsas*, of which Leach has formed his genus *Dipsas.*

Lamarck enumerates fifteen species; but it is certain that more must exist in those countries over which scientific research is now rapidly extending.

ANOLIS. A genus of saurian reptiles belonging to the family *Iguana*, having, like the rest of that family, teeth on the palate, and resembling the lizard agamas (*Polychrus* of Cuvier,) of which the marbled lizard of Guiana is the type more than any other genus. They also have some resemblance to the Geckos; but still they possess sufficient characters of their own for constituting them a genus.



Anolis equestris.

Their most distinguishing character, and the one in which they are intermediate between the genera that have been mentioned, is the structure of the feet. These in the lizard agamas are covered with scales on the whole of the under part, and in the geckos that part is without scales, and formed into adhering pads or suckers, by means of which they can run up or down a perpendicular wall, or even along the ceiling of a room or the roof of an oven with the back undermost. The anoles have scales on the under sides of the terminal joints of the toes only; the next joints are extended into soft pads, but these have not the property of adhering, so that the animals can neither walk with the back undermost, nor ascend a perpendicular surface in any other way than by holding on with the claws.

Their haunts correspond, of course, with the structure of their feet: they do not inhabit places so humid as those sometimes inhabited by the lizard agamas, and they do not climb so exclusively as the geckos. They inhabit places which are dry, sometimes on the ground or the rocks, and sometimes on trees, in the holes of which they usually nestle, but they do not climb to any considerable height. They are agile and lively, leaping much, and one of the chief uses of the pads on the toes is to break their fall, or make it easy, though it also prevents their slipping upon the irregular substances over which they pass with much rapidity and ease. The claws, instead of being flattened, as in those genera which walk chiefly upon the earth and occasionally on humid ground, are long, round, considerably hooked, and have some resemblance to those of climbing birds.

The head is rather elongated and straight, and covered with small five-sided or six-sided scales. The body is rather slender and firm, the ribs being united to each other below, and forming a series of rings all round the body. The tail is in all the species as long as the body, and in some longer, tapering to a point, compressed in some and nearly round in others. In those which have it compressed, the processes on the upper part of the vertebræ are produced, and support a row of scales, which form a serrated ridge or keel, continuous from that of the upper part of the body. Those in which the tail is nearly round have the serrated keel along the ridge of the body, but not on the tail.

In both, but most conspicuously in those that have the tail compressed, the hind legs are much longer and stronger than the fore ones; so that, while, in walking, the arm from the elbow downwards is nearly perpendicular, the knee joint is bent till the heel almost touches the thigh. This structure indicates considerable power in leaping by the extension of the knee joint; and the formation of the tongue shows that the animals must take their prey by leaping. The tongue is not protrusile beyond the mouth, nor divided, or furnished with fibres, or an adhesive liquor, or any other means of prehension: it is smooth, and adheres to the floor of the mouth for nearly the whole of its length. The animals cannot therefore capture their food with the tongue, but must leap at it and seize it with the jaws. That structure necessarily gives much more liveliness of motion than if they lay in wait, and used the tongue as a snare in the capture of their food. It is to be presumed also that they live upon larger prey than the tongue-feeding saurians. Their food is not exclusively animal, for some of them climb trees, or shrubs at least, and feed upon berries. They have the power of inflating the throat to a very considerable extent; but the use of that operation in any reptile (or fish) possessing the means of performing it, is not known.

All the species, of which there are about eight, are inhabitants of the warmer parts of the American continent. They are most numerous within the tropics, but some of them are met with in the southern parts of the United States. They are always found in dry places, and generally where there are hard and shrubby plants, but seldom in the thick forests in the bottoms.

It has often been stated by authors that they answer the same purpose in the Western continent, as the chameleons do in the Eastern; but the structure and habits of the two genera are so different, that no useful or even possible analogy can be established between them, any more than between the greyhound and the glutton, which, comparing one class of animals with another, is about the best comparison that can be made. The chameleons have anisodactylic feet: all the toes of the anoles are free. The chameleons have prehensile tails: the anoles have not. The chameleons have the power of distending the skin of the whole body, by the copious inflation of their ample lungs: the anoles merely inflate the throat, without any particular reference to the operation of breathing. The chameleons have very large and prominent eyes, though in great part covered by the eye-lids; and they can look two ways at once, to such an extent of divergent squinting, as almost to command the whole horizon: the eyes of the anoles are of moderate size, placed like those of the majority of animals, and looking both the same way. The chameleons are liers in wait, and capture the whole of their food by means of the tongue, which is protrusile to perhaps a greater proportional extent, and with more rapidity, than that of any other animal: the anoles catch all their prey with the mouth, and arrive at it by speed of foot. Such are the grounds of analogy upon which it has been so often said and repeated that the two genera occupy the places of each other in the two great continents. Perhaps the best expression of their characters, in few words, is to say that the chameleons are singular; the anoles admirable.

They are indeed the beauties of the saurian race: their forms are light and delicate; their colours often rich; their expression mild and gentle, yet (as one would say) full of speculation; and their motions more resemble those of birds than of merely footed creatures. They start, they leap, they climb, bounding now here now there, as if life were to them one continued holiday; and as they are found chiefly in the dry and healthy spots, they seem to point out to man where he should take up his dwelling. They are mild and inoffensive, but they are not timid: they do not skulk away from our sight, as is the case with those reptiles which have the power of mischief in them. They move, "come when they are called," for if the chirp of at least some of the species is imitated, they come out of their holes, and approach man, as if to know what he wants, eyeing him mildly but steadily all the time. This curiosity, or whatever it may be called, often costs them their lives, as the boys call them, and then capture them with snares. They are, however, animals which it is desirable to protect, as well on account of their beauty, their lively motions, and their frank and confiding manners, as of their usefulness in keeping down those broods of insects which are both annoying and destructive. In short they are animals, in whatever point of view we survey them, which man should always think twice before he destroys.

The species are not very well made out, but the most beautiful, though rather the smallest in size, appear to be those which have not the serrated keel on the basal part of the tail. Among them the red-throated anolis (*anolis bullaris*) is the finest in its colours. Its prevailing tint is green with golden reflections in some lights, and a black spot upon each cheek. The dilatable skin on the throat, when not inflated, is of a dark russet colour; but in the course of the inflation it passes through many tints, with more rapidity than even the skin of the chameleon; and when fully distended, it is of a bright cherry red, glossy and shining. This species is found to a considerable distance northward in the United States, and also in the West India islands. With the exception of the keel on the tail, and differences of size and colour, the species are so much alike that the detail of them is unnecessary for popular purposes; and enough has already been mentioned to point out their general characters, and the place they hold in the scale of animated being.

ANOMIA (Linnæus, Lamarck, Cuvier). A genus of shells, belonging to the class *Acephalophora*, order *Lamellibranchiata*, and to the family *Ostraceæ*, of De Blainville's system of Malacology.

The animal inhabiting this shell is very much compressed, the edges of the mantle very thin, not adhering, and furnished on the outside with a row of tentacular filaments; the abductor muscle is thick, divided into three portions, of which the largest passes partially through a notch on the lower valve, adhering to marine bodies by a small *calcareous piece* at its extremity, which in some species is wanting. The shell is adherent, irregular, inequivalve, inequilateral, and much resembling an oyster; the inferior valve flatter than the upper one, divided at the summit into two branches, forming a notch or an aperture of an oval form; one of them, large and thick, forms the part to which the ligament is attached; the superior valve is much larger and more convex, with an oval excavation beneath the summit, for the other attachment of the short and thick ligament; a subcentral muscular impression, divided into three parts.

Like the oyster, the anomiæ possess no locomotive power, they live and die on the spot which gave them birth; the small osseous portion by which they are affixed to marine bodies has been mistaken by some persons for a third valve, but it is, in fact, no more than the thickened extremity of the tendon, or interior muscle of the animal, by means of which it becomes attached to the object on which the egg was hatched. It is so constructed as to close the hole or notch, at the summit of the upper valve, when the muscle of the animal is contracted. In this genus the smaller perforated valve is the lower one, being always placed in contact with and conforming to the shape of the substance upon which it lies; in the oyster, on the contrary, the larger and the most concave valve is the lower one.

Poli describes the animal of this shell as being very similarly organised with that of the oyster, and its habits appear perfectly congenial.

It is not easy to characterise the shells of this genus; Lamarck enumerates nine species, other writers have mentioned a greater number; but from their assuming in most cases the form of the substance to which their thin valve is affixed, that circumstance may be presumed to have led to an erroneous conclusion of their being distinct species.

Anomia ephippium.

The two divisions De Blainville has made are such as have the small osseous appendage to the muscle, and such as have it not; the first is exemplified in any *Anomia ephippium*, the other is the *A. squamata*, which is affixed by the valve itself, a figure of which is here given, to the object on which it was hatched. Lefranc admits ten fossil species.

The difficulty of defining properly the classification of these shells, probably occasioned their having been named anomia, α, not, and νομος, law, (*without law*), implying that they did not fall within any law or system of arrangement established with respect to other species of mollusks.

ANONACEÆ. The fourth order of the Jussieuan system. It contains nine genera, *viz.* Anona, Monodora, Eupomatia, Asamina, Uvaria, Unona, Artabotrys, Xylopia, and Guatteria. Of these there are forty-seven species. The genera are all trees or shrubs, and mostly tropical. The fruit of the Anona

ANONA SQUAMOSA. *a*, the flower; *b*, fruit; *c*, the same in section, showing the position of the seeds; *d*, seed; *e*, the same in section, showing the position of the embryo.

are estimable; and, under the name of Custard Apple, will be more fully described. The Ethiopian pepper of the shops is the fruit of the Uvaria; and in South America the bark of the Xylopia is used for cordage.

ANOPLOTHERIUM. A genus of extinct animals, belonging to the order *Pachydermata*, which is found exclusively in the fossil state. Nothing, perhaps, can show more fully the perfection and precision to which the study of comparative anatomy has been brought, by the indefatigable researches of the great naturalist Cuvier, than his discovery of various extinct genera and species of animals, by the application of those invariable laws upon which organised animal bodies are formed. By the application of these laws, the skilful comparative anatomist is enabled to re-construct, as it were, the whole animal, and to form certain and indisputable conclusions as to their habits and mode of living; thus bringing into view beings which have long ceased to be inhabitants of this earth: many of which are distinguished as much by their remarkable forms, gigantic stature, and massive proportions, as by peculiarities of structure, to which nothing analogous at present exists.

These results being so remarkable, a concise account of the principles upon which such conclusions are founded may not be considered uninteresting. The fundamental law upon which every other depends is, that every organised being must of necessity be considered as a whole, possessing a peculiar system of its own; every part of which is in strict accordance with each other, and all concurring to produce a certain definitive action by a reciprocal reaction. No change can possibly take place in any of these parts without producing corresponding changes in the others; and consequently each part taken separately exhibits and enables us to ascertain all the others. Thus an animal whose stomach is so constituted as to enable it to digest recent flesh only, will have every part of his frame strictly in accordance with this arrangement. A peculiar system of dentition must prevail, as the teeth must be sharp-edged in a greater or less degree, as they have flesh more or less exclusively to divide; and their bases will be solid, according to the quantity and size of the bones they will have to break. The jaws must be powerful, and the condyles of a peculiar form. These, however, would be of but little service to the animal, unless it had claws for seizing and tearing its prey. These, again, absolutely require a peculiar construction of the phalanges, joined to a facility of rotation in the fore arm, and analogous changes in the humerus. The whole system of their organs of motion for pursuing and overtaking their prey must also be strictly conformable to the other parts. On the other hand, it is perfectly evident, that all hoofed animals must be herbivorous, as their feet afford no means whatever of seizing their prey; accordingly we find their masticating and digestive organs correspond with this peculiarity, their teeth having flat unequal crowns suited to the bruising and grinding their food, and every other part agrees strictly with their peculiar system.

Such are the principles which Cuvier applied to the investigation of the bones found in the plaster-quarries near Paris; and he quickly, to his astonishment, perceived that there were many genera and species among them which had no living antitypes. On those immutable laws which nature has prescribed to living beings, he proceeded to reconstruct these ancient animals, and a creation, long since extinct, rose to his view. Nothing, he says, can express his pleasure as he perceived, on the discovery of each peculiar character, the consequences he had predicted gradually and successively unfold themselves. Thus he found the feet correspond with the peculiarities announced by the teeth, and the teeth, in like manner, with those indicated by the feet. All the other bones proved also conformable to the judgment previously formed by him from the consideration of other parts. Among these he found one genus distinguished by two characters unknown in any other animal, viz., by the teeth being in a continuous series without any intervening gap (a structure observable in man alone), and also by having two toes, whose metacarpal and metatarsal bones are separate on their whole length. From the circumstance of the canine teeth being short and similar to the other incisors, he gave it the name of *Anoplotherium*, or a beast without weapons. It has six incisors in each jaw, one canine, and seven molars on each side, both above and below. The first three molars are compressed, the four others in the upper jaw are squared with transverse crests, and a small cone between them in the lower jaw; they form a double crescent, with a neck at the base. The head of this animal was of an oblong form; and there is no appearance indicative of the existence of a proboscis. They are divided into three sub-genera, the anoplotheria, properly so called, the xiphodus, and the dichobuner, whose distinctions are founded upon slight differences in the crescents and other parts of the teeth. Of the first division, the *Anoplotherium commune* was about the size of a wild boar, but much longer in the body, and had a tail of enormous length, equalling, if not surpassing, the body; and there is reason to believe that its thickness was also very considerable. There is also another species, a little smaller, called by the Baron *An. secundarium*. There is but one *Arphodon* known; it appears to have been very slender and delicately formed, much like the gazelle; to this the name of *An. gracile* has been given.

Of the last division, the *Dichobunes anoplotherium leporinum* is about the size of the hare; and besides its sub-generic characters, it is distinguished from the two former divisions by its having two small and slender toes on each foot at the sides of the two great toes. Two other species have been observed, which appear to have been very small animals.

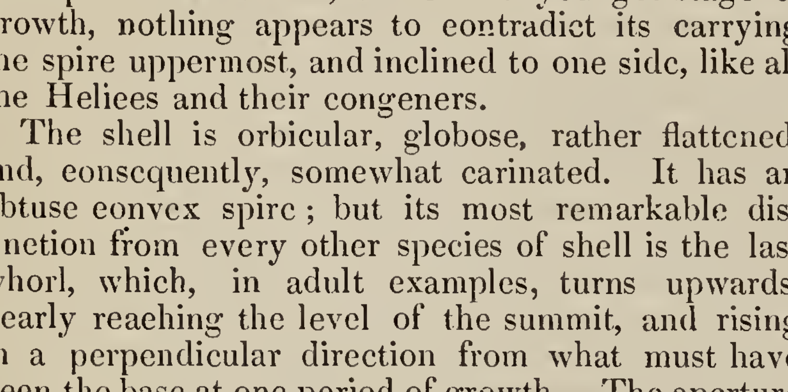
These remains have hitherto been found only in strata, belonging exclusively to the Eocene period of

Lyall. They are exceedingly abundant in the fresh water formations, which are exposed in the gypsum quarries near Paris, and have also been detected sparingly, in similar deposits, in other parts of France; and a tooth referrible to this genus has been discovered in the quarries at Binsted, in the Isle of Wight, which also belongs to the same period; and it is not improbable that future researches will point out various other localities of this highly interesting fossil.

ANOSTOMA (Lamarck, Cuvier). *Helix ringens* (Linnæus). *Tomogerus* (De Montfort). In De Blainville's system of Malacology, this shell is classed with the family *Limacinea*, of the order *Plumobranchiata*, in the class *Paracephalophora*.

The animal inhabiting this extraordinary shell is not as yet known; but it may reasonably be presumed to differ in *many* respects from that of the well-known Helix, with which it was classed by Linnæus; though De Blainville is of opinion that it probably differs but *little*. The structure of the shell clearly indicates that on the completion of the final whorl, with its reflected and dentated lip, the animal would then be compelled to carry its dwelling with the spire downwards; while in a younger stage of growth, nothing appears to contradict its carrying the spire uppermost, and inclined to one side, like all the Helices and their congeners.

The shell is orbicular, globose, rather flattened, and, consequently, somewhat carinated. It has an obtuse convex spire; but its most remarkable distinction from every other species of shell is the last whorl, which, in adult examples, turns upwards, nearly reaching the level of the summit, and rising in a perpendicular direction from what must have been the base at one period of growth. The aperture is rather oblong than round, and horizontally attached to the body-whorl on the upper side, presenting two strongly defined teeth or plaits on the columella, with three, or sometimes more, on the right side. The outer lip is reflected on the side not affixed to the spire; and, in one of the species, there is a very small puncture on either side of the lip, not noticed by Lamarck. It may not unaptly be compared in form to that of an antique Etruscan lamp.



Anostoma globosa.

There are two species described, the *Anostoma globosa* and the *adepressa*. The former is here figured in two points of view. They are terrestrial shells inhabiting the East Indies, and are extremely rare. The name is derived from *ανος*, upward, and *τομα*, a mouth, (the mouth turned upward,) which is so admirably descriptive of its peculiar structure, that it appears singular De Blainville should have adopted De Montfort's name, *Tomogerus*, without he wished, by so doing, to distinguish it, beyond all manner of doubt, from the genus *Anastomus*, established by Illiger in ornithology, and Cuvier's *Anastomus* in Ichthyology, with which it might possibly be confounded by persons ignorant of the derivation of its name, or from a similarity of sound to many ears.

ANOTTA (Linnæus). Called by botanists *Bixa orellana*, a South American genus of three species of lofty trees; class and order *Polyandria Monogynia*. Natural order *Bixineæ*. Generic character: calyx of five sepals; sepals imbricated in opening, knobbed at the base; deciduous petals inversely egg-shaped; stamens below the germen; filaments like threads; anthers ovate; style elongated, the top like a thin tongue; capsule like an egg or heart, rough, two-valved, valves furrowed, seed contained in a farinaceous pulp; albumen fleshy; seed-leaves foliaceous and flexuose.

ANSER—Goose. A well-known genus of flat-billed and web-footed birds, belonging to the family of *Anatidæ*, and usually ranged between the swans and the ducks. Considered as a genus they are, perhaps, the least aquatic of the family, and feed more upon vegetable substances. By the semipalmated goose, of which the feet are very imperfectly webbed, they are connected, in some respects, with the swans and also with the cranes. The chief structural peculiarity is the convolutions at the bronchial end of the trachea. But in the cranes and swans, these, if extensive, are imbedded within the bones; whereas in the semipalmated goose they pass outside the muscles, and along the side of the animal just below the wing, without any defence save the common integuments. The investigations of Mr. Yarrell show that these convolutions are not always of the same form; that they are sometimes on the right side of the bird, and sometimes on the left; and that, whatever side they are on, the clavicle on that side is enlarged, and has upon its inner surface a projecting point to which the trachea is attached. If these variations in the internal structure of the bird are general or common, it is rather unusual, as the structure of the internal parts is generally understood to be uniform in the same species.

At the other end of the genus, the geese approach the ducks, in the Egyptian goose, which, in the form of the trachea, in the male at least, has an enlargement of bone similar to that in the fresh-water ducks, or those of the first division. See Anas. In the latter bird the habit is found to correspond with the structure; for the Egyptian goose is, in some respects, as much a duck as the sheldrake: it has even the bright colours of the ducks, which are not found in any of the geese properly so called.

Besides the two species that have been mentioned, it is not known that any of the geese have an enlargement of the trachea; and they are seldom in the habit of finding their food under water. If the expression can be admitted, they are more of grazing birds than any others with which we are acquainted. Their leading characters are: the bill of moderate length, narrowed to the tip, and the upper mandible rased at the base, so as to make the height there more than the breadth, and having a nail on the tip; the body thick and heavy; and the legs strong, and articulated near the centre of gravity. For the general appearance and characteristics of the species, see Goose.

ANT (*formica*.) A very common, very numerous, and highly interesting genus of insects, with the appearance of which every one is so well acquainted, that a minute description of it is not necessary. They belong to the order *Hymenoptera*, or that of insects with four membranous wings, in which the nervures or shafts are comparatively few and inconspicuous. They belong to that section of the order which have no auger, an instrument for boring holes in the bodies of animals or the substance of vegetables, in order to place their eggs there for the purpose of being hatched; but the females of many of the order have stings with which they inflict poisoned wounds. The ants however have no stings, but, at the place where the sting is usually situated in others of the section, they have glands which secrete a very pungent liquid; and this liquid they are sometimes supposed to insinuate into the wounds which they make by biting with the jaws, thereby causing a great increase of pain to the creatures bitten.

Cuvier forms the ants and some closely allied species into a distinct family, under the very appropriate name of *Heterogynia*, from the very peculiar distinction of the sexes. Of these there may popularly be said to be three: males, females, and undeveloped females; that is, individuals which have, the wings excepted, the external form of the perfect females, but the sexual parts are merely rudimental, and they have no sexual propensities. These last greatly exceed the others in numbers and in activity; and, except in the analogous cases of the bees, and some other insects which inhabit warm countries, they form quite an anomaly in the history of nature.

It should seem that the lives of all those insects, which have this threefold distribution of sexes, are exceedingly laborious, more so perhaps than those of any other living creatures; and, as they are exceedingly numerous and have many enemies, they multiply at a rate much greater than that of most insects. Their young are also reared with more care, and their social habits, their diligence, their ingenuity and their courtesy to each other are quite exemplary. The eggs of most insects are left to nature; they are deposited in or upon substances which shall afford nourishment to the young as soon as they are hatched, and thus they are left to find their way to the last or perfect stage of their existence as they best can; their parents being in general previously dead, the father before the eggs are deposited, and the mother very soon after. All those insects, which are thus reared without attention, grow up to be perfect males and females when in their last stage, though they have no sexual distinction or propensity in the previous ones; and the grand work, in the case of many at least, in this last stage, is to secure a generation of successors and then to die; and the life which is devoted to this single purpose is often only a few hours, and sometimes only a few minutes in duration.

Of these insects, many are often exceedingly laborious, and curious in their labours, when in the grub or larva state; but among the ants and the other species which, like them, have the greater number consisting of undeveloped females, no labour, excepting perhaps that of spinning a cocoon in which to pass the chrysoloid state, is performed till they arrive at the last and perfect stage. But it is curious to notice that the analogy of insect life is so far kept up as that the ones which have a perfect sexual development are exempted from almost all labour in these, excepting such labour as is connected with the perfecting and depositing the eggs, the subsequent rearing of which devolves chiefly upon the undeveloped females.

There are some indeterminate points in the natural history of ants, which throw doubt and perplexity upon the whole of it; and though there is certainly no inconsiderable degree of analogy between ants and bees, of which the history is more complete, yet the analogy is of that loose and imperfect character which is very apt to mislead. In the more social bees it is doubtful whether there is even, for any length of time at least, more than one perfect female, except young ones, which are rearing a succession. In large communities of ants there are many such females, and it does not appear that they evince towards each other the same deadly hostility which is shown by the female bees. In both races, the pairing appears to take place external of the nest or habitation, and probably only in the atmosphere on the wing. When the eggs of both are deposited, they are to appearance all exactly alike, whatever is to be the character of the beings produced from them; and it is here that the analogy becomes imperfect, and the natural history of the ants obscure. It is tolerably well ascertained that in bees, at least in the common hive bees, the undeveloped females, or the neuters, or workers, or nurses as they are sometimes called, have the means of determining what sort of progeny shall issue from the eggs; and that, by placing an egg of the very same description in three different magnitudes of cells, and feeding and attending it in different ways, they can make it a common worker, a male, or a female (or queen, as the perfect females are styled) just as they see occasion. We know nothing of the principle which leads them to do the one or the other; and therefore we say that it is the result of *instinct*, a name which comes in very conveniently to conceal our ignorance in all cases where, in truth, we know nothing about the matter. By means of this instinct, however, it is evident that a community of bees, whether great or small, can so regulate the numbers of its three classes of members, as that they shall always be in that proportion to each other, which is most conducive to the present welfare and the succession and continuation of the race. See Bee.

It is here that our knowledge of the ants is deficient, and hence the whole of the natural history is broken and imperfect; for the natural history of any animal resembles a machine in this, that the whole of its parts, taken together, are no better than the most imperfect of them taken singly. The neuter, or nursing ants, certainly do pay a great deal of attention to the young, up to the period of their escape from their cocoons or pupa cases, after which they are able to shift for themselves as independent members of the community. They expose them to certain genial degrees of temperature, generally in the mornings; they remove them from the strong action both of heat and of light; they remove them from the influence of damp and rain; and they feed them when in the larva state. But it has not been ascertained that the difference of sex, or of development of sex, depends upon any specific treatment which the young receive in any one of these stages; and this is the grand blank, the filling up of which is necessary, not only to complete the natural history of ants, but to make it rational and philosophic so far as it goes. Analogy would lead us to suppose that the neuter or working ants, on which the burden of the community, in a great measure, devolves, should have such a controlling power as well as the working bees; but this is a case in which we can trust but little to analogy.

There is another point upon which information is also much wanted, and that is the time and manner of development of the wings both of the males and females. Those organs are not required for the ordinary purposes of life as they are in the bees, and therefore the undeveloped females, that is by far the great majority of ants, never acquire them. In the males and females they are apparently absolutely necessary for the purposes of pairing, and the continuation of the race; and for that purpose both sexes appear in great numbers furnished with them in the warmer months. But when we endeavour to ascertain when they come, how they come, whether they accompany the sexual development, or come after it, whether the perfect sexed animals are furnished with them when they escape from their pupa cases, or whether they are developed by some future process in the individuals themselves, or some difference of treatment from the rest of the community, we are left entirely in the dark, and here again, of course, the history of those very singular creatures is quite vague and uncertain.

In the ants, as in all insects which contain a number of individuals with the sexual powers undeveloped, all the males that appear are perfect animals; but to all useful and efficient purposes, they are mostly inferior even to the undeveloped females. They seem formed for the single operation of pairing only, and that once performed they die. They have no weapons of self-defence; they have scarcely the means of finding their own food; and they take no share whatever in the labours of the community. Among bees, as soon as their seasonal services are over, they are tumbled headlong from the hive or slaughtered on the threshold; and among the ants, after they have once left the hill for their seasonal purpose, it does not appear that one of them returns, or is indeed suffered to return.

The probability is that, in our climate at least, neither the males nor the perfect females of the ants survive the winter; and that only the labourers, or undeveloped females, pass the inclement season in a dormant or hybernating state, until the weather becomes so genial as to call them forth anew to energy and labour. This point, however, depends upon the indeterminate one already mentioned, and till that is determined, it must remain indeterminate also.

It is true that no winged ants appear in the earlier months of the season, although then the wingless ones are equally numerous and industrious. But no sooner does the strength of the equinoctial heat come, than winged ants are by no means rare in every locality in which ants of any description are met with; and in those places where ant hills are large and numerous they are often found in such numbers as absolutely to cloud the atmosphere. Now, the question here is, whence come those winged ants? Do they hybernate wings and all, or are they transformed out of the working ants, by some process which these have the power of performing? The latter may be the case with the females, but with the males it is exceedingly doubtful; and the only account which, in the present state of our knowledge, is, that we know nothing about the matter. It is true that the pairing of the warm months *may*, as in the autumnal pairing of aphides, impregnate more than one generation of females; it is also true, that the perfect females, after they have deplumed themselves of their wings, and deposited their brood of eggs, may turn to the state of imperfect females; and in that state pass the season of hybernation, and also the more early and inclement portion of the spring and summer. None of these suppositions, however, account for the midsummer appearance of the males; and as they are merely conjectures with regard to the females, this, one of the most important points in the natural history of the race, must remain indeterminate until accurate observation shall throw the necessary light upon it.

But wherever they come from, or in what manner soever they are produced, the males and females do meet in the air, in vast numbers, at the season which has been mentioned; and as this is the only instance we have of the pairing of the parties, we must consider it as the annual preparation for the grand reproduction of ants.

Indeed, it seems expressly, and only for this period, that both males and females are furnished with wings, as they never use them at any other time or for any other purpose than that of meeting each other on those aërial excursions. There are some circumstances too, which would lead to the supposition that the wings and the sexuality are developed by the joint action of the season, and of some peculiar mode of treatment on the part of the labourers. Every one knows that the common ants are very sensitive to the weather, and that the passage of the slowest and most momentary cloud over the sun will produce a change in their operations. At large ant-hills, they may, for some time previous to the appearance of the winged swarms in the air, be seen restraining the escape of both males and females, hauling them back by main force by the wings and legs, and taking them under cover, and keeping them there, as if aware that the proper time, or rather the proper temperature, for their departure had not arrived. After the swarms in the air begin to make their appearance, there is no longer any struggle to prevent either male or female from quitting the ant-hill; and after that period there is no instance of the working ants hurrying a male back to the hill, or giving themselves the least trouble about him. With the females it is different; and numbers of the working ants may be seen running about in all directions in search of these, which are understood never to alight from the wing till they are impregnated, and as seldom to mount into the air afterwards.

The crowds in which winged ants appear in some countries at certain seasons show the vast number of these insects, without taking into account the neuters, which are a large majority of the whole. To those who have been in the habit of examining them, the males are easily distinguished from the females, they are considerably smaller, much more slender, and so feeble on the legs that they can hardly walk. The wings of the females are very thin and filmy, but in other respects they are robust, and they walk well. It does not appear that the male ants are able at all to contend with the wind, which bends their wings, and blows themselves before it like dust. Indeed it is probable that none of the males remain in the air longer than a single day; and it is doubtful whether the females remain as long. The absence of the queen bee from the hive, when she sallies forth for the same purpose, does not exceed half an hour, and yet a foundation has been laid for an entire new swarm of bees, drones, queens, and altogether. As the female ants are not understood to be individually so fertile, there is no reason to suppose that their aërial excursions are of longer duration. Hence, in an ant country, the number in all the successions must be absolutely countless; and, as is the case with bees, the males probably are manyfold more numerous than the females. Clouds of males chiefly, if not exclusively, have often been blown on the surface of waters, to the shores of the sea, and into the streets of cities, in some of which they have been so numerous as that they might have been taken up in handfuls; and in some parts of this country, the roads crossing the pine forests, which on particular soils are favourite places for ants, are literally covered with them. It should seem, however, that all which are found thus have answered their purpose in nature, and so it is of little consequence whether they fall down and die in one place, or be wafted by the wind to die in another.

The females escape these casualties by their superior strength, and their descent to the ground; after which they remove their wings as quickly as possible, and are then not very easily distinguishable by a common observer from the ordinary labourers.

The casting off of their wings is a grand era in the lives of female ants; for at that time each one seems to be inspired with the ambition of founding a nation. This erratic propensity causes the distribution of ants, even those that are the most social, to be so very general in places well adapted for them. It is not many, however, at least not the majority, which are able to carry this scheme of general ambition into effect, for the workers are just as inhabitive as the females are discursive; and, as if they felt their bones ache (or rather their muscles and skins, for they have no bones) with the labour of building their existing cities, towns, and palaces, they exert themselves to the utmost in order to prevent these from becoming desolate through a failure of their progeny, which, though they can tend with the fondest and most solicitous care, they can in no wise originate but by laying hold of and detaining their fertile sisters. From very large ant-hills the number of scouts sent out upon these occasions is proportionally great, and so is the extent of surface over which they range. Indeed the inhabitants of a very large ant-hill have, generally speaking, to work much harder than those of a smaller one, inasmuch as their larger supply of food must be brought from a greater distance; so that even among ants there seems to be a practical inconvenience in overgrown communities, and the labourers must toil more severely both in finding their own food, and in nursing and feeding the young, than when the community is of more reasonable size.

The writer of this article has seen very large deserted nests of the common wood ant, while there were little hillocks all round, inhabited probably by fragments of the erewhile mighty nation; and the scene had at least some resemblance to the Arab building his hut or erecting his tent beside the mighty remains of Thebes or of Tadmor: so pass the ancient glories of ants as well as of men. In other somewhat overgrown hills of the same species he has been able to trace more great roads diverging from the hill in all directions than diverge from London to the different parts of England; and what is most remarkable for travellers, individually so light, the roads, though across pretty sturdy short heather, were beautifully smoothed and beaten. In the immediate vicinity of the hill, that is, for the first yard or two, there appeared to be but little passage from one to the other, as if that portion of the pastures had been but little worth searching; but as the distance increased, the roads became gradually obliterated, as there the industrious inhabitants seemed to begin seeking food for themselves and their young in real earnest.

From the number of labourers which are on the alert all day long about the time of the pairing, from the comparatively little that there is then to perform in the ant-hill, as there are then no males or females to feed, and the consequent probability that the workers, having nothing to do but to find their own food, enjoy their holidays, and rest in the fields whenever they are weary, there is as wonderful a distribution of them over all surfaces that can be considered ants' pastures, as there is of females in the air; and though it has sometimes been said that a female goes to found a colony for herself, nobody has ventured to set it down in print that they have seen the fact in free nature with their own eyes, and indeed it is not very probable, nor is it very clearly established, that a female is capable of rearing and feeding her brood without assistance, or even that she lives to do so. Her grand work seems to be accomplished in the laying of the eggs, and as individuals, proved to be perfect females, have never been found assisting in nursing in the larger societies, it is rather against the analogy that, under other circumstances, they should perform the whole of that labour.

It is certain, however, that many females never return to the society from which they departed, for it is ascertained that wandering parties of the labourers, and probably parties from different hills or nests, finding situations fitted for their purpose, seize these stray females and found new colonies.

When the females have got rid of their wings, and have been conducted to an old hill, or had a new one made fit for the purpose, they immediately begin to deposit their eggs, which is done under ground, and even the average number is not known; indeed, at this point the history begins to be very obscure, as though the eggs can be found at all stages of their growth, from the recent in which they are small round white, and of a pearly lustre, up to that in which the perfect animal is ready to be liberated from its film, they are always under the immediate and most solicitous care of the workers.

These carefully regulate the depth in the earth, degree of heat, moisture, and all other circumstances necessary for hatching the eggs. As the process goes on the eggs enlarge very considerably in size, especially in length, and gradually become transparent; and when they have acquired their greatest length, the larvæ come out as grubs, which are of an arched form, but incapable of performing any very important functions, or even feeding themselves. That is done by the all-attentive neuters, which, as the larvæ are much more delicate than the eggs, are more solicitous in guarding them against extremes of temperature; and they feed them from their own stomachs, but whether with their common food partially digested, or with a peculiar fluid, has not been clearly ascertained. At all events, though these undeveloped females are barren they are not dry nurses. In this there is involved another argument against the fertile female ever rearing a brood without the aid of these nurses. How many of the nurses are necessary for the feeding of one larva, does not appear to have been examined; but from the voracity with which almost all larvæ eat, it is highly probable that more than one are required; and, therefore, to speak about one mother supporting two or three dozen, looks at least very suspicious. When the larvæ are full grown they enclose themselves in membranous cocoons or cases, in which they undergo the rest of their changes until they are fit for coming into activity; and it has been said that the males and females, at least, have not the power of extricating themselves from those cases till they are liberated by the workers. If this is true it shows at what stage of the business the sexual development begins, and seems to indicate that ants have the same means of keeping their perfect sexed animals in confinement till they are wanted, as the bees have of confining their germs.

The attachment of the workers to these cocoons is even greater than that to the eggs or the larvæ. They may be seen bringing them out in the fine fresh air of the morning, taking them in when the heat and light are too strong, sheltering them from the rain, and if a breach is made in their dwelling the cocoons are the first objects of their solicitude; and although they are more than double the size of the ants themselves, the little creatures run as fleetly with them to places of safety as if they had no weight whatever. The working ants are valiant in the breach of their dwelling, determined in their strifes and combats, and most perseveringly industrious in the search of their food; but it really seems that the care of larvæ and cocoons, the latter especially, is their great ruling passion to which they willingly sacrifice all else, and for which they are ready to give up their lives. In the common garden ants it is scarcely possible to find an individual in possession of a cocoon without finding other individuals constantly tendering their assistance; and if the aperture, through which the one in charge attempts to get it into the concealment of the nest, is at all unmanageable, a number of others come unbidden to assist, some hauling and others pushing till the treasure is safely lodged. So fond indeed are they of cocoons, that when the little nests or colonies of this species are near each other, parties of the one are very apt to make free with the cocoons of the others, and battle and strife to ensue upon the point, though it does not appear that different tribes of this species, or indeed of any species, fight much or at all about the prizes they meet with. It seems, indeed, that one of these labourers can no more see a cocoon without trying to nurse it, than a cat can see a mouse without endeavouring to catch it.

It is probably upon the strength of this instinct (for we must call it an instinct as we have no knowledge of its cause), that certain species of ants have been described as invading the dwellings of others, for the purpose of carrying their partially developed young into *slavery*. The species against which this charge has been brought are principally the blood-red ant (*F. sanguinea*), and the reddish-brown ant (*F. rufescens*), both of which are common in central Europe, though not hitherto observed in Britain.

That they do invade the hills or nests of feebler ants, and carry the larvæ, and especially the cocoons, from thence to their own dwellings is highly probable, and it is probable that all ants which can gain the mastery either by individual strength or by numbers, do the same; and it seems the general law of their nursing instinct (if the term can be allowed), that the labouring ants of every species bring home to their own dwelling all the impregnated females and all the developed young that they can; but that they seize them for the purpose of enslaving them is purely a gratuitous assumption; and it may be said, without fear of contradiction, that there never was an ant of any species found attempting to make one of another, or of the same species, perform its labour for it. There is, in fact, the most perfect equality among the labourers in an ant-hill; and labour seems to be so much their enjoyment, that they will not, upon any occasion, stand by and see it done by another. When any task is too great for an individual, that individual seeks for, and speedily obtains, assistance; but however hard it has laboured previous to the coming of the assistance, the arrival of that is rather a signal for fresh exertion upon its part, than for any slackening of its labour. The true explanation of the alleged slavery seems, therefore, to be that the ants take the cocoons merely for the purpose of nursing them with the same tenderness and solicitude as they would nurse those of their own species.

It has sometimes been said that there is a division of labour among ants—that one squad fight, another keep the hill in repair, a third bring in provisions, a fourth nurse the young, and so on. But as all animals work according to their organisation, and, generally speaking, up to it, it would be contrary to the general law of nature to suppose any division of labour without corresponding differences of organisation. And upon examining ants, it is found that the labourers, if unoccupied, are equally ready and willing to put their hand (such hand as it is) to any work which is requisite for the welfare of the community; and the confidence with which they all go in quest of assistance, and the readiness with which they receive it, are among the most beautiful traits in their characters. The task which defeats an ant is, as compared with those performed by the strongest of the larger animals, a most formidable one; for an ant will carry in proportion as if a bull-dog were carrying a buffalo. Therefore, among all the innumerable substances which are brought home to the nest in the season of the larvæ, there is not one, even the very largest, but which a single ant will attack, and labour with all its might to move along. If the prize cannot be made to stir, the ant after some time darts off at a tangent, and encircles the prize round and round, widening the circle a little each time, and proceeding with so uncommon velocity that one would suppose an ant's mode of rest to be increased exertion. If in the course of these gyrations it meet with any of its associates, they are sent in the direction of the prize; and in this way, one who attends to the common garden ants, may often see a large caterpillar, an earthworm, or some other goodly prize, borne lightly to the nest by the united strength of twenty, thirty, or forty, at which a single individual had been tugging in vain for half an hour previous.

Among the species which inhabit in larger societies, the field-ants and the wood-ants especially, the labours of a much larger party are often required. They can contrive to move along the largest beetles, and even a young mouse; though it is not known that they attack these animals in the living state. But whatever may be their labour or the number engaged in it, all the individuals appear equally on the alert and equally skilful in the performance of it. Whether it be in the mere seeking of their own food, in the preparing of their habitation, or in any other duty, they are all equally prompt and able without ruler and without counsellor. Thus they pass a most energetic season, till their supply of food in the fields fails, and the temperature sinks too low for their remaining in a state of activity. Previous to this they seek their dwellings, and in the inmost recesses of these cluster together, and so pass the inclement months in a torpid or hybernating state. Their nests are constructed of various substances according to the habits of the species, and according, as it should seem, as materials are to be found. Some dig into the trunks of trees, seldom, however, till these have begun to decay. Sometimes they excavate the earth in bare places, sometimes they make portions of the mud edifice artificially, and sometimes (as in the case of the wood-ants) the hill is exclusively made of little bits of sticks, so placed as that while perfectly water-tight and laid without any apparent order, they can be entered at almost any point. Some naturalists mention having found the nests of ants excavated in solid clay: these must be a wonderful species, inasmuch as both the physical and physiological arguments against ants hybernating in clay, or even living comfortably in it, are exceedingly strong.

The different modes in which ants construct their dwellings, and the different situations and materials which they select, has led some, not a little whimsically, to apply to them the names of certain human trades, such as masons, carpenters, and others: at best those comparisons are childish and trifling, and at worst they have not a little of the "odium" which is said to attach to comparisons generally. The operations of these insects have no resemblance whatever to those of the human artificers after which they are misnamed; and, therefore, besides being beneath the dignity of natural history, these misapplications of names invariably produce one or other of two results, they either give young and ignorant persons an erroneous meaning, or they destroy to them every vestige of meaning.

Any one who considers the very general distribution of ants, their countless numbers, their great strength as compared with their size, their unwearied assiduity in labour, the promptitude with which they assist each other, the care which the rearing of them compared with that of most other insects requires, and the curious fact that by far the largest majority of the race are formed for labour only, must see that the place which they occupy in nature cannot but be one of very great and general importance; and though they are sometimes a little (and it is but a little) annoying in gardens, disfigure dry meadows and pastures with their hills, and sometimes speed the termination of rotting trees, there is no question that the services which they render counterbalance, many thousand times over, any little ravages they commit. The exertions of some of the smaller ones in clearing the leaves of trees from that honey-dew with which aphides cover them, to the great injury of their growth, is much noticed. But honey-dew is far from being the principal food of the ants; they do not go into grounds unfavourable for their nidification for the sake of this substance. Over some of the tough clays where ants cannot subsist in the earth, the leaves of the hedges may be often found so dripping with honey-dew, as that a large phial might be filled with it in no great length of time; and yet in the places where it was so abundant, the writer of this article has never seen a single ant, though there was no want of wasps, and also of wild bees, feeding away with apparent gusto. So also it does not appear that the presence or the absence of aphides on the fruit-trees, has much influence on the number of ants.

The food of the species which inhabit different localities no doubt varies; and there is little question that, besides honey-dew, most of them are fond of sugar, gum, and all the sweeter exudations of trees; but still their staple food appears to be animal matter, either those larvæ which are injurious to plants, or small carrion, the incredible quantity of which that occurs, especially after the Midsummer rains, would otherwise very seriously taint the air, even in climates which are not excessively warm. A district which swarms with ants is always a dry district, and as such its atmosphere is sweet and favourable to human health; a clayey district, where they are few, has invariably a rank and unwholesome atmosphere; and though the presence of the ants is not to be considered as the only cause of healthiness in the one place, and their absence of unhealthiness in the other; yet they are accompaniments, inseparable from the result, and therefore, to some extent, influential in bringing it about.

But ants are valuable, not merely on account of the creatures and substances which they eat, but on account of the creatures which eat them. Some of the finest, both of song and of gallinaceous birds, are understood to be fed almost exclusively in their very young state upon the cocoons of ants; many other birds feed largely on them; and in foreign countries there are peculiar genera of animals formed exclusively for feeding upon ants.

ANT-CATCHER (*myiothera*). A genus of birds which feed almost exclusively on those insects from the capturing of which they are named. They are found in both continents, chiefly in the warmer latitudes, and in the wastes and forests where ants are so very numerous; but though these forests are the chief haunts of the greater number, they are never found high upon the trees, but rather hopping about among the lowest branches. On the ground they are more at home, their tarsi being long and stout, and their feet altogether admirably adapted for walking. They, in consequence, run with great swiftness, and appear never to tire while the ants are abroad. They are, in fact, upon the ground, very similar to what swallows and swifts are in the sky, and capture their wingless prey as adroitly as these capture winged insects.

Their pastures, especially in the tropical countries, are so highly productive, that they are generally found in packs, or small flocks, and often several species may be found on the same ant-hill feeding away in the greatest harmony. They are, of course, day-feeders, and as the ants are out at certain times of the day, and in certain states of the weather only, their feeding is limited to these times. But the ants are so numerous, that an ample supply may be picked up in a very short time, so that the lives of the ant-catchers are much less laborious than those of many other birds.

These ant-catching birds are rivals of the ant-eating mammalia and reptiles, especially of the ant-eaters properly so called, some account of which will be found in the next article. But the two do not come upon each other's ground. The mammalia attack the ants in their hills, and bring them out by breaching these; and the reptiles generally watch by those paths along which the ants pass in great numbers. Both of these too, in general, capture by means of a protrusile tongue, which is limed with a very adhesive viscus, so that many ants are taken at a time. The birds, on the other hand, capture them singly with the bill, and capture them whenever they are inclined. Each ant-feeding class has thus its particular season, and the one does not interfere with the other; even if they did, the ants in the warm countries are so numerous, and they breed so fast, that there would still be ample provision for them all.

The ants, the *white ants* [see TERMITES], and various analogous tribes, act a very important part in wild nature in the tropical climates. They are scavengers to a very great extent in clearing the wreck and rubbish both of animal and of vegetable matter, consuming even the boles of large trees, which are constantly decaying in those places, and which, if they were to remain, would not only taint the atmosphere with pernicious gases, but would float away when the rains came, and thus exhaust and impoverish the soil. This preventing of the matter, which has once been organised, and which, on that account, is fit for the support of new organisations, from floating away, is a very important matter; and, but for it, the whole of those tropical countries which have extremes of dry and humid seasons, would be in rapid progress toward the desert state. But the matter is taken up by those countless myriads of insects; and in them it lives anew for a season. Then the birds and other vertebrated animals feed upon them, and it passes into new forms of life, each one supporting some other, and the whole preserving and maintaining the fertility of the country. This is what may be termed nature's mode of culture: the fungi among plants, and the insects among animals, take hold of that which is on the brink of ruin; and from them it passes from race to race, till at the end of the circuit it arrives at the most stately trees of the forest, and the largest animals which feed and repose in their shade; so that, by a circle of minor destructions, the grand destruction of the whole is prevented.

The forests of tropical America are at least among the places where this natural system is in the fullest operation, without having been interfered with by man; and from the peculiarity of its structure, and the large portion of it which is in a state of nature, the system, perhaps, extends more polarly in North America than in any other region on the globe. The valley of the Mississippi, especially that on the right bank of the river, from Louisiana northwards, skirting along the Rocky Mountains, has its atmospheric action from north to south, and south to north, between the tropical climates and the polar ice; and though the average temperature is much lower, there are many features in it which have at least a relation to tropical ones. Among the rest, there are numerous ants and ant-catchers, some of which are better known than those of more southerly latitudes. The species best known, indeed the only one which has hitherto been found in these northern parts, is

The *Rocky Mountain ant-catcher* (*mygiatheria obsoeta*), of which the following description will serve as a specimen of the American birds of the genus.

"The Rocky Mountain Ant-catcher," says Lucien Bonaparte, in his addition to "Wilson's American Ornithology," is six inches long. The bill, measured from the corner of the mouth, is more than one inch in length, being slightly curved almost from the base; it is very slender, being nearly two-eighths of an inch in diameter at the base, and only the sixteenth of an inch in the middle, whence it continues to diminish to the tip; and is of a dark horn colour, paler beneath. The feet are dusky; and the length of the tarsus is seven-eighths of an inch. The irides are dark brown; the whole plumage above is of a dusky-brownish, slightly undulated with pale, tinted with dull ferruginous on the top of the head and superior portions of the back. The sides of the head are dull whitish, with a broad brown line passing through the eye to the commencement of the neck. The chin, throat, and breast are whitish, each feather being marked by a longitudinal line of light brown. The belly is white; and the flanks are slightly tinged with ferruginous. The primaries are entirely destitute of undulations or spots; the tail-coverts are pale, each with four or five fuscous bands; the inferior tail-coverts are white, each being bifasciate with blackish brown. The tail is nearly two inches long, rounded, broadly tipped with ferruginous yellow, and having a narrow black band before the tip; the remaining part of the tail is of the same colour with the wings and is obsoletely banded, these bands being more distinct on the two middle feathers, which are destitute of the black and yellowish termination: the exterior feather is dusky at tip, marked by four yellowish-white spots on the exterior, and by two larger ones on the inner web.

"The specimen of the rocky mountain ant-catcher we are describing, is a male, shot in the month of July, and possibly not adult. As it is the only one brought by Major Long's party we cannot determine the extent or nature of the variations the species may undergo from age, sex, or season.

"The note of this bird is peculiar, resembling the harsh voice of the terns. It inhabits the sterile country bordering on the river Arkansaw, in the neighbourhood of the Rocky Mountains, where it is frequently observed hopping on the ground, or flitting among the branches, or weather-beaten, half-inclining trunks of a species of juniper: when it flies among the crooked limbs of this tree, it spreads its tail considerably, but was never seen to climb. They were generally observed in small associations of five or six individuals, perhaps composing single families."

The following general observations, by the same author, are also worthy of quotation.

"The ant-catchers may justly be enumerated amongst the benefactors of mankind, as they dwell in regions where the ants are so numerous, large, and voracious, that, without their agency, co-operating with that of the *Myrmecophaga jubata*, and a few other ant-eating quadrupeds, the produce of the soil would inevitably be destroyed in those fertile parts of the globe. The ant-hills of South America are often more than twenty feet in diameter, and many feet in height. These wonderful edifices are thronged with two hundred-fold more inhabitants, and are proportionally far more numerous, than the small ones with which we are familiar. Breeding in vast numbers, and multiplying with great celerity and profusion, the increase of these insects would soon enable them to swarm over the greatest extent of country, were not their propagation and diffusion limited by the active exertions of that part of the animal creation, which continually subsist by their destruction.

Ant-Catcher.

"The ant-catchers run rapidly on the ground, alighting but seldom on trees, and then on the lowest branches; they generally associate in small flocks, feed exclusively on insects, and most commonly frequent the large ant-hills before mentioned. Several different species of these birds are often observed to live in perfect harmony on the same mound, which, as it supplies an abundance of food for all, removes one of the causes of discord which is most universally operative throughout animated nature. On the same principle, we might explain the comparative mildness of herbivorous animals, as well as the ferocity and solitary habits of carnivorous, and particularly of rapacious animals, which repulse all others from their society, and forbid even their own kind to approach the limits of their sanguinary domain.

"The ant-catchers never soar high in the air, nor do they extend their flight to any great distance, without alighting to rest, in consequence of the shortness of their wings and tail, which, in fact, seem to be seldom employed for any other purpose than to assist them in running along the ground, or in leaping from branch to branch of bushes and low trees—an exercise in which they display remarkable activity. Some species, like the woodpeckers, climb on the trunks of trees in pursuit of insects; and it would appear, from their restless habits and almost constant motion, that their limited excursions are entirely attributable to the want of more ample provision for flight. The ant-catchers are never found in settled districts, where their favourite insects are generally less abundant; but they live in the dense remote parts of forests, far from the abodes of man and civilisation. They also dislike open and wet countries.

"The note of the ant-catchers is as various as the species are different; but it is always very remarkable and peculiar. Their flesh is oily and disagreeable to the taste; and, when the bird is opened, a very offensive odour is diffused, from the remains of half-digested ants and other insects contained in the stomach.

"The plumage of the ant-catchers very probably undergoes considerable changes in colour. The size of the sexes is different, the female being much larger than the male. Such variations may have induced naturalists to consider many as species that really do not exist, as such, in nature.

"The nest of these birds is hemispherical, varying in magnitude, according to the size of the species, composed of dried grass, rudely interwoven; it is fixed to small trees, or attached by each side to a branch, at the distance of two or three feet from the ground. The eggs are nearly round, and three or four in number.

"The discovery of any species of this genus in the old world, is quite recent, and it had previously been believed that the genus was peculiar to South America; and though the existence of ant-destroying birds was suspected in other tropical regions, they were supposed to be generically distinct from those of the corresponding parts of America, as was known to be the fact in the case of the ant-eating quadrupeds. This opinion was founded on the admitted axiom, that nature always varies her groups in remote tropical regions having no communication with each other. The reverse, however, is the fact, in the case of the ant-catching birds, as we find perfect analogies between the species residing in those distant parts of the globe, even throughout the different sections into which the genus may be divided."

The Asiatic species are in general more gay in their plumage than the American ones, but their habits are nearly the same. They are not birds of the cultivated and thickly-inhabited districts, but of the wilds, and they are but seldom seen in proportion to their numbers. None of them are birds of much show or display, or in any way of popular interest; their peculiar place in the system of nature being the only point of importance in their history. It is not understood that any of them are migratory, though, during the season when the heavy falls of rain confine the ants to their hills and other burrows, they must in so far change their food, and pick up such other insects as they find among the lower branches of the trees. They are not met with in places which are flooded during the rains, because such places are not suited for the habitations of ants; neither are they so abundant in the deep and tangled forests as in those where the trees are straggling and interspersed with dry open patches.

ANT-EATER (*Myrmecophaga*). A very singular genus of mammalia, belonging to Cuvier's order of *Edentata*, or "toothless;" and with the strictest propriety so arranged, as not one of the genus has a vestige of a tooth in either jaw. They are all natives of the warmer parts of South America, and perform nearly the same part in the economy of nature there as is performed by the pangolins, or scaley ant-eaters of the eastern world. They have been, by some naturalists, confounded with the "ground pig" of the colonists of southern Africa, *Orycteropus* (earth-foot) *Capensis;* but that animal is different both in structure and in habits. It has grinding teeth, though of peculiar structure, whereas the true ant-eaters have none.

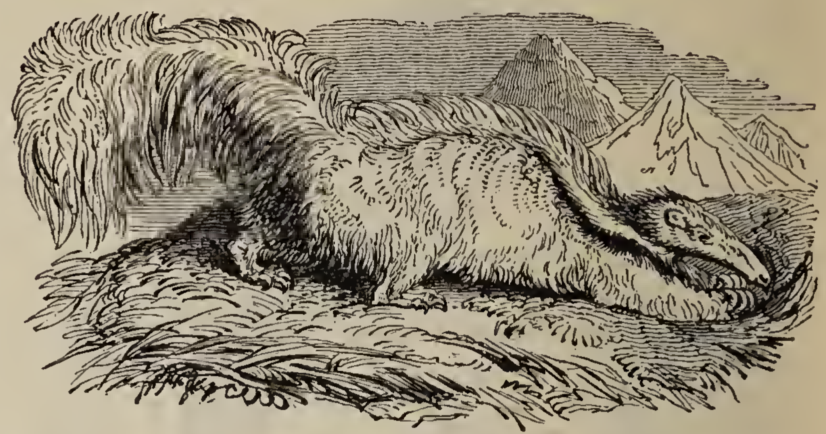
The connexion between the teeth and hair of animals has often been noticed. The hairless dogs, which are met with in some parts of the world, generally have the teeth deficient; and though it has not been established in the human subject, that the falling off of the hair is always accompanied by dental decay; yet it has often been noticed that a dry and unhealthy state of the hair very generally accompanies disease of the teeth. In the different orders of animals, the correspondence is more remarkable; and the hairy covering of the edentata, whatever may be their other characters, always has some resemblance to the substance of scales, or rather perhaps to *baleen*, or, as it is improperly called, whalebone. This holds, whether the animals have grinders, or are wholly toothless, and also whatever may be the country or the situation of their residence. The sloths which inhabit trees, and never come to the ground if they can avoid it; the ant-eaters which never climb; the echnida of New Holland which burrow in the ground, and the ornithorynchus of the same country, which inhabits pools of water; all have the hair flat or tubular, or in some way less apparently connected with the living part of the animal, and more withered and dead to appearance than the hair of the toothed mammalia.

But the ant-eaters have many peculiarities of structure which are well worthy of attention; nay, in some respects, they have a slight resemblance to the human subject. The females have the mammæ on the breast, and two in number; and though the animals walk upon all fours, it is the hind feet only that can be properly regarded as walking feet. These are strictly plantigrade, that is, the whole length of the tarsus or foot bone comes to the ground, and so affords a very broad and firm base. The first joint above the ground is a forward bending one, or true knee; and the toes, whatever may be their number, have all their phalanges united; and the claws on these are small and weak. They are thus slow-walking feet; but not adapted for climbing, leaping, or any other function.

The fore-feet are very different, and their structure shows that walking is only one of their secondary uses. The number of toes varies in the different species; but they are always fewer on the fore-feet than on the hind. The form of the fore-feet resembles that of small rakes or pronged hoes; and as such they are awkward in walking. The phalanges of the toes are united in these as well as in the hind feet; but they are armed with much larger and more formidable claws. These claws are, in repose, folded inward upon the palm, by the action of elastic ligaments; and even when they come into use, they do not open beyond a right angle to the line of the palm. Thus they form an instrument which is very peculiar, but which is admirably adapted to the habits of the animal; and which, in turning over the mould with ease and speed, is superior to our garden rakes and pronged hoes.

When, however, it comes to be used for walking, it is not so convenient. From the position of the claws (which, though intended for a very different purpose, bear some resemblance to that in the sloths), the animals cannot walk on the palms of the fore-feet; and besides, its so walking would speedily blunt and wear the claws, the only instruments on which the animal has to depend for unearthing its food. It therefore walks on the outsides of these feet; and as they do not apply well in that position, its walk is slow. Even when driven to a trot, it moves with difficulty, and slower than the ordinary walk of most animals. Walking, except at its ordinary stealthy pace, is not, however, an operation essential to its mode of life, for which it is as admirably adapted as the fleetest animal that scours the plain or bounds from cliff to cliff.

The bodies of all the species are long, the heads long, and the tails very long. The proportions and uses of the parts will be most clearly and briefly stated in a notice of the largest species which has the peculiar characters of the genus in greatest perfection. That species is the great ant-eater (*Myrmecophaga jubata*).



Great Ant-Eater.

This species is a large animal. The head from the point of the snout to the ears is about thirteen inches, thence to the insertion of the tail nearly three feet and a half, and the tail nearly two feet and a half in the solid, and a foot more to the points of the hair. The whole length is thus about eight feet. The height is about three feet three at the shoulder, but half a foot less at the croup. The hair, excepting on the head, where it is short and close, is shaggy, and dry like that of the sloths. The mouth is small and the tongue slender, but remarkable for its length. It is in the form of a worm. When in repose it folds back within the mouth; but it is protrusile to the length of at least eighteen inches beyond the snout; and the celerity with which it can be protruded and retracted forms a remarkable contrast with the sluggish locomotion of the animal. This celerity of motion in the tongue is, however, just as necessary for a large animal which feeds on such small food as ants, as swifter progressive motion would be unnecessary. The tongue is covered by a viscid secretion, by which the ants are captured; and as it is laid over them, they are rubbed off against the palate when the tongue is doubled back into the mouth.

In order to understand how the parts of this rather singular organisation work, we must suppose that the animal has arrived at the side of an ant-hill, or other burrow of social insects; and that he is hungry and inclined to feed. There is every reason to believe that his sense of smell is acute, as is generally the case with long-snouted animals, and that in immediately feeding he is fully as much guided by that as by the sight of his small eyes. Well, he arrives at the ant-hill, his broad hind feet forming a firm base, and his long tail balancing him on those feet as on a pivot. The fore-foot is then extended to its utmost stretch, but in its general position, and with the claws curving a little backwards. In this species, the claws on the fore feet are four in number; the first and fourth smaller, but the second two inches, and the third two inches and a half in length, strong in proportion, and grooved on their posterior surfaces. The stroke of the foot plunges these into the ant-hill up to the roots; and the animal pulls the foot home, tearing a rugged furrow in the insect earth. The ants, as is their habit, instantly come to the breach in numbers; and while they are in agitation there, the tongue is protruded over them and withdrawn at the rate of about twice in a second, many dozens being captured at each time; and when the first breach is cleared, others are made in the same manner. But though the animal subsists in this manner, it is said never to get fat, notwithstanding its indolence at those times when it is not feeding. It is capable, however, of enduring great privation in the way of food, which might be inferred from its sluggish habits. The position of repose is that of partially rolling itself into a ball, with the snout doubled on the breast, the legs brought together, the long and bushy tail covering the outer part, and the whole animal having something the appearance of a bunch of withered grass; and probably much of its defence from enemies depends on this position, in which it spends the greater portion of its time.

The muscles of the fore-legs of these animals are powerful, and the claws are formidable; and on these accounts, the efficacy of the latter, as weapons of defence and even of attack, appear to have been much exaggerated. It has been said (though those who have said so do not pretend to have seen it in the fact) that the great ant-eater, or "ant-bear," as it is sometimes called, can seize with its claws and hug to death the most formidable and active beasts of prey that inhabit the same countries. But the probability is, that the animal has been endowed with the powers of the sloths, and also of the bear, after which it has improperly been named. The claws of the sloths are clutching claws, and their feet do act against each other while they move along the branches in quest of their food. Hence it is perfectly natural to suppose that a sloth would clutch an enemy upon the ground; and as its clutch habitually supports its own weight without effort, it is natural to suppose that it would be formidable to other animals. Bears, too, have hugging feet, which they use in climbing trees, and it is also quite natural that they should use them against their prey, or against an enemy. But the great ant-eater does not climb, or clutch with its paws, or hug any thing in any one of its natural habits; and it would be at variance with all the analogies of nature to make it a new animal, either when it attacks or when it defends. The position of the fore-paws in repose, is with the claws folded down upon the pad of the palm; and if the animal get hold of any thing there, it might retain that hold; though it is against the general rule to suppose that the position of repose should also be the position of excitement.

The ant-eater is not the only animal which has got credit for performing feats which are equally contrary to its habits and inconsistent with its organisation. The works of travellers and compilers in natural history are full of them; and they are sometimes suffered to vitiate the pages of those who ought to know better. These matters spoil natural history as a useful study, and therefore no better service can be rendered to the reader than the exposure of them, and no means so certain for preventing the inexperienced from falling into such mistakes, as a careful study of the structure and habits of animals. From these, and these alone, we can learn what the animal is best capable of doing; and when we have ascertained that, we may rest assured that it will be the first thing the animal will attempt.

Great ant-eaters are pretty generally distributed over all the warmer parts of South America; but they are not numerous in any one locality. The low and swampy grounds, by the sides of streams and pools, or in the forests, are his favourite haunts, though he never either climbs in the wood or swims in the water. He is wholly a ground animal, but a surface one and not a burrower.

They are slow-breeding animals. The female has only one at a birth; she carries it on her back, and tends and nurses it for more than a year. They are remarkably quiet and harmless animals, living and feeding among the ant-hills, and not, so far as is known, offering or doing harm to any other creature. So retired are they, indeed, that they are considered as rare, even in their native forests. The Indians and negroes eat the flesh of this species, which is not unpalatable; but, as is the case with several others of the ground animals, it has a rank musky flavour, which is rather offensive to Europeans. The species now noticed is the only one of the genus which is literally an "ant-eater" and a dweller exclusively upon the ground; and the remaining species, though they agree with it in having no teeth, have many of their characters so different that each of them might perhaps be made a separate genus.

The *tamandua* (*M. tamandua*), is a much smaller animal than the ant-eater properly so called. It is five inches from the snout to the ear, one foot nine to the origin of the tail, and the tail is about one foot four; making the total length three feet and a half; but the tail and snout are shorter in proportion, and the body is stouter. The legs are also stouter in proportion, and the animal walks much better upon them, the fore legs being more plantigrade, and the claws not quite so much in the way. The feet are adapted for climbing, in which operation the animal is assisted by its prehensile tail, which grasps round the branches readily and with a firm hold. It stands more equally on its feet than the ant-eater, and is altogether a more lively-looking animal. Its fur is also short and silky, and its tail round and tapering, covered with very short hair. There are five or six varieties enumerated, but as the differences between them are chiefly in colour, it is probable that they are merely climatal. The prevailing tint is dull straw-colour, variously marked with black, or with a silvery hue. These markings may be the effects of age, as the young are all over of a dull straw-colour. The female has two pectoral mammæ, like the ant-eater; like that she has but one young at a birth, and carries it on her back, but for a much shorter time.

This species inhabits the thick and pestilent forests of South America, spending the greater part of its time in the trees; and, indeed, the ground under its haunts is so often under water, that it could not find footing there. It feeds upon tree insects and wild honey, reaching the latter in the very tops of the trees by means of its feet and tail. It also sleeps in the trees, but not suspended, after the habit of the sloth. When it prepares for repose it finds a hole or secure crevice, where, rolling itself up partially as a ball, it remains in safety.

The *little ant-eater* (*M. didactyla*—two-toed), is as improperly called an ant-eater as the species last mentioned. This species is about the size of the common squirrel, has the snout less produced than the last species, and the feet not so well adapted for walking. The fore ones have however powerful claws (two on each foot), bearing some resemblance to those of the sloths; and the tail is very prehensile

The dimensions of this species are small compared with those even of the tamandua. Its length is only about thirteen inches and a half, of which the head occupies less than two inches and the tail above seven. The tail is very thick and strong at its insertion, and tapers gradually to the tip. The colours are either bright yellow with the back brown, or silver gray with the back darker. The hair is soft and silky, but in some parts curled or matted at the points. The tail is slightly annulated with the prevailing colours of the body, except a portion of the under side near the point, which is naked, as is usual in that organ when prehensile. The hind feet are squat and flat, with the phalanges of the toes united and covered with hair. They have four small claws on each. The fore-feet (which the animal can use like hands, resting on the hind feet, and holding on with the tail if necessary) have only two claws on each, an outer and very large one, and an inner and smaller, which lies in the curve of the former.

Like the last-mentioned species, these animals live in the trees, and feed chiefly upon wasps and other insects in the larva state, which they are very dexterous in capturing with their nippers. It is probable that they also use the tongue in feeding, though certainly not so habitually as the anteater properly so called. As is the case with many of the other inhabitants of the dense forests in the humid parts of South America, they repose during the day, at least in the dry season, when the larvæ are unable to bear the heat of the sun. They partially roll themselves in balls, remaining anchored by the prehensile tail, and sometimes suspended by it. The females of this species are described as having four mammæ, two on the breast and two on the belly, and yet they are said to have only one young one at a birth. The details of their economy and habits are not, however, very well known.

They, as well as the tamandnas, are, strictly speaking, tree animals at home only among the twigs and branches; and though the absence of teeth and the protrusile tongue show that their food must be of so soft a nature as not to require any process at all analogous to mastication; yet they differ so much from the great ant-eater, as hardly to admit of a common description. Neither is there any other known species in the same forests with which they can, even with as much propriety, be classed. They are very peculiar animals, and belong to a quarter of the world which has many peculiarities both in its climate and its productions.

ANTELOPES (*Antilopus*). A very numerous and highly interesting genus, or rather, perhaps, family or tribe of animals belonging to the order *Ruminautia*, or those which chew the cud. For the general characters of the order, the most valuable to man in the whole animal kingdom, see "*Ruminantia*."

The species of antelopes are so numerous, and they differ so much from each other, that no popular description could be so framed as equally to apply to and express them all; and yet the family likeness among them is so strong, that no one who has carefully studied even a few of the species can find much difficulty in pronouncing, the very first time that he sees it, whether any new species is or is not an antelope. The other animals to which they have most resemblance, both in structure and in habits, are the goats, though in the shape and covering of their bodies, some of them more resemble deer; but still there is not much danger of mistaking them either for the one or the other.

Yet when we come to state in words what the difference is, we are at a loss. Where both deer and antelopes have horns, the distinction between these is abundantly clear, as the horns of deer are not true horns, but annual appendages to the head, growing at the surface under a skin which remains till they attain their full size, after which it begins to shrivel and they to harden, so as to be in the top of their strength during the pairing season, after which they fall off, sooner or later, according to the climate and the habit of the animal. In all cases they are deciduous; and like the leaves of deciduous plants which drop when mature, they leave a new skin upon the places to which they were attached, or rather it is the formation of that skin which interrupts their connexion and causes them to fall off.

The horns of the antelopes are, on the other hand, true horns; their cores are permanent elongations of the cranial bones, sheathed with real horn, which grows at its inner surface where it is in contact with the core of bone; and although it probably in all cases receives an inner layer of new substance every season, it is in all cases persistent, or remains during the life of the animal, unless destroyed by accident.

The distinction between the antelopes and goats is by no means so clear; as not the goats only, but the sheep and ox tribes have horns of the same general structure, so that in attempting to found a distinction upon the horns of these, we are reduced to some mere difference of form; and though, when we see them together, it is not very difficult to say, either from the shape or the texture, which animals the horns belong to, it is by no means easy to express in words in what the difference consists.

The other characters are not more easily expressed, whether we take the size, the general shape and air of the body, the form of the muzzle, the presence or absence of *lachrymal sinuses* under the orbits, of secreting pores or follicles in the groin, or any other character. The most general popular character is, that every antelope is in its form the type of agility; and in their motions they are as agile as they look.

The period of gestation in many of the species is imperfectly known, but there are some reasons for thinking that it varies considerably, being about eight months in some of the larger species, and not more than five or six in the smaller. Their young are never understood to be more than two at a birth, and seldom more than one; but the females are generally, though not invariably, furnished with four teats, which are *inguinal*, or in the groin. The number of teats, however, proves nothing as to the number of young; for the cow, which has four, has twins less frequently than the ewe, which has only two.

In general, the limbs of the antelope are very clean in their make, firm in their joints, elastic in their tendons, and powerful in their muscles. The hoofs, of which there are two walking ones on each foot, are neat in their form and very firm in their texture. The general covering of the body is hair, short and smooth, but not silky or woolly. In some, however, there is harder and more produced hair in the form of manes, beards, elongations on the throat, *scopæ*, or knee tufts on the fore-legs, just below the carpal joints, and other appendages.

In general the sexes are both of nearly the same colour; and when they differ they follow the general law, in the change being in the adult male; for the young males are like the females. Colour in animals has, however, so little to do with original difference of species, and depends so much on circumstances, that nothing useful can be founded upon it.

The ears of the antelopes are in general long, rather narrow and pointed. The tails vary considerably in different species, being very short in some, moderately long in others; in some with a brush at the point, in others with short hair on all their length, and in others again entirely covered with long coarse hair.

But though it is difficult to select any characters by which the antelopes may be systematically described as one tribe, or even as several subordinate groups, they have at least one character in common, which cannot fail to recommend them to the student of natural history: they are the children of wild nature, and of wild nature in those places which lie the most remote from the culture and the cognisance of man. The cliffs and ledges of mountain rocks, the bush-tangled wastes on the tropical plains and the margins of the arid wildernesses, are the native habitats of the antelopes. There they bound, and spring, and career, fleet as the winds; now balancing themselves where one would hardly imagine there were foot-fall for a bird; now clearing the jungle as if they were winged creatures; and now bounding along the arid plain as if they were actually endowed with a principle of levity. To those who have been accustomed only to the motions of the more sober animals, to the heavy tread of the ox, or the pattering trot of the sheep, the antelopes present something truly novel. From some unseen hollow among the cliffs, one of these animals will vault up perpendicularly, and alight upon all-fours on a pinnacle only a few inches in breadth, and on which any animal with which we are familiar in England would empale itself if it attempted to descend. There it will stand in perfect security with the feet all touching each other and the spine bent upwards like a bow, surveying at its leisure the new horizon of which its elevation has given it command. And it not only seems a bow, but it is one—a bow fully bent and itself the arrow; for no sooner has it espied a new footing to its mind than it bounds off again though the distance be many fathoms. Nor, if it is upon a journey of some length, can it be contented with walking or even with running along the plain; but proceeds by a few fleet steps and a still fleeter bound alternately, as if it were utterly unable to keep its own energy within limits.

From the great diversities of size, power, and appearance, which are observable among antelopes, we may naturally look for corresponding differences of habit. Some accordingly are highly gregarious, and assemble in very numerous herds, especially at particular seasons; others are found in small packs, and others again solitary, or at most in pairs among the rocks. Every where, however, they have to bear great extremes of climate; and thus, in no instance has their great energy been given to them in vain.

Some species may be more localised and permanent in their dwellings than others; but the general habit of the animals is migrant, and there is probably not one district which they inhabit, in which antelopes are not at some season of the year compelled to travel in quest of food. It is this tendency to seasonal mobility which forms the grand and distinguishing character of the race, and the one upon which, in a useful point of view, it is best to describe them. No doubt, in some of their localities, they approach pretty closely to some of the goats, as they also do in structure and appearance; so that there the line of distinction between the two races is not very definite, but that is only at particular points.

Of the other Ruminantia, the buffalo keeps his savannah, and the wild ox his dell or his forest, and only shifts a little way with the seasons. The sheep and the deer too, in the state of nature, have no very strong migratory habits; and though the mountain goat is sometimes forced to descend in the inclement season, his seasonal journeys are not to any very great distance. These races, in general, inhabit the regions where upon the average they can find food during the greater part of the year; and, therefore, there are large tracts of the world which, though seasonally rich in food for ruminating animals, are not adapted for them.

These are chiefly those regions which during the dry season are parched and foodless, but which are speedily covered with luxurious herbage as soon as the rains set in; the greater part of Africa, many portions of Asia, and some of America. In Europe they are comparatively few, and confined to the Alps, the Pyrenees, and other mountain ridges. The species on these mountains is the chamois; and although it has many of the appearances of the antelopes, it has many of the habits of the goats. The same may perhaps be said of the American species, of which the one best known is also a mountaineer: and indeed it is in the mountain species where it is difficult to draw the line, and say with certainty what is an antelope and what a goat. The common distinction that antelopes have the section of the horns round, and goats have it angular, is arbitrary, proves nothing, and is not to be depended upon.

In giving some notice of at least the more remarkable species of these very interesting animals, we shall not pay much attention to system. There is merit no doubt in many of the systems; but from the very nature of the case not one of them can be regarded as any thing like perfect. New species are often occurring; and the classification is chiefly founded upon the form of the horns, which, though it may serve to distinguish one individual or species from another, is connected with no other known character or habit. Hence our plan, as the only popular one, must be to notice the appearance and habits of the several species as briefly and clearly as possible.

The Prong-horned Antelope (*A. furcifer*). This species is an American, inhabiting the northern part of that continent; but migrating a little to the southward in the winter. It is a very handsome, beautiful, and agile animal, measuring nearly four feet and a half from the nose to the insertion of the tail, and standing three feet in the height of its back, which is a straight line and equally high at the shoulders and the croup. The line of the abdomen is also nearly straight, the chest full, the body compact and firmly set on the legs, which are finely formed. The tail is very short. The neck is "at gaze," carried at right angles to the line of the body; the ears are large, and the eyes prominent and bright; the hair on the head and neck, except a rudimental mane on the latter, is short; but that on the body is matted, and the hairs are tubular, or rather in the form of hollow cones, of small diameter as compared with their length. These tubular hairs stand out and give the animal a shaggy appearance. The tubular hair appears to be a defence against the snow and cold in winter, for it does not come on till the end of the season, and it is shed in the beginning of the next. This is a curious winter change in the covering of an animal; but as these tubular hairs contain air, they form an excellent protection against the very low temperatures to which the animal is exposed in its more northerly haunts. The colour of the points on the upper part is fawn; and that of the roots pale blue with a reddish blush. The interior of the fore legs and thighs is white; and there is a white disc surrounding the insertion of the tail. In summer the general tint has more of the reddish blue, but as it passes gradually into the fawn colour, the different individuals are differently tinted at that season. As the hair elongates and becomes tubular it loses its gloss, and no doubt also much of its vital action.

Prong-horned Antelope.

The greatest peculiarity, and the one in which it differs from all other known species with persistent horns, is in the form of these appendages. They are branched, or have a little prong or antler projecting forward from each. This prong is not far from the root, and the part below it is rough, knobby, and of a whitish colour, while that toward the tip is round, polished and black, though curved forwards and inwards. Those naturalists who have written on this animal do not mention whether the bony core has the prong and the irregularities on the basal part, or whether these are confined wholly to the horny sheath. Pronged horns, somewhat different in form, and especially more compressed laterally in the basal part, have been brought from America, from the same regions that are inhabited by this animal; but whether they belong to the same species or to a different one, has not been made out. The males only of this species have horns.

The range and also the numbers of these animals are considerable. They are not found in the very extreme north, nor on the summits of the Stony Mountains; but they range along the secondary hills from the neighbourhood of Hudson's Bay, as far south as the confines of Mexico, and westward nearly to the shores of the Pacific. They migrate southward as the cold sets in, and prefer the open plains and slopes to the woodlands. They are gregarious, and associate and migrate in considerable flocks. The females produce one or at most two at a birth. Their flesh has a rank and "goaty" flavour, and is not very much esteemed even by the Indians, unless when they are very much in want of food.

The Chamois (*A. rupicapra*). As the *prong-horned* is the only American species which has hitherto been made out in a manner perfectly satisfactory, so the *chamois* is the only one which extends into Western Europe, and has its principal locality in that quarter of the world. It is not however confined to Europe, but is found in the mountainous parts of Western Asia, although, hitherto, it has not been seen to the eastward of the Caspian sea. It follows the line of the European mountains, both on the right and the left of the valley of the Danube; but it affects the most lofty and inaccessible situations, never descends into the lower plains, and is perhaps more abundant in the Alps than in any other locality.

The body of the chamois is that of a goat, and the legs also have the firmness of those of that animal rather than the airy lightness of those of the true antelopes. The neck is more slender than that of the goat, and the head, only that the horns are different, and the tips more produced, has much of the air of that of the furcifer. The horns are black in the colour, perfectly smooth, erect for about two-thirds of their length, and then turned back into hooks, very sharp at the tips. The horns are not above six or seven inches long, and they are smaller and less hooked in the females than in the males. The hair on the body is shaggy, deep fawn colour in summer, fading brown in winter, and bleaching into a sort of straw colour before that season is over. The females drop their kids in March or April, after a gestation of five months; they rarely have two at a birth, and, contrary to many of the family, they have only two teats. They continue to suckle their young till about October.

There are few who have not heard of the daring and the perils of chamois hunters in the Alps; and the animal itself is truly a wonderful creature among the crags and precipices. It is not very large, only between three and four feet, and about two feet in height at the shoulders; the croup is as high; and indeed leaping animals, which leap in any other way than to pounce upon their prey, in general stand about equally high on both pairs of legs. But the chamois appears as if it were wholly made of elastic springs, and it absolutely gets up precipices that have very little slope, and down those which are quite perpendicular, by playing at "ducks and drakes" against the rocks, as a stone does upon the water when projected nearly parallel to the surface. In ascending, it contrives so to strike the rock as that the force of the rebound projects it upwards, and it can repeat those rebounds, rising several feet at each. When it descends it is just as adroit in breaking its fall; and if it requires a rest, the smallest ledge, or even a pinnacle will afford it a secure footing. It seems indeed to be as much made for the mountains as the mountains are for it, and one almost regrets that the chamois should ever be hunted.

But the hunting of it is no holiday sport. Its senses are keen and its vigilance great, so that to come upon it requires both silence and patience; and as, when alarmed, it speeds like the wind, the hunter of the Alps dearly wins his game. After all, the prey which he takes is in all probability taken only from the birds of prey or from famine. The pastures on the Alps at chamois height are but scanty, and could not, in all probability, admit of any increase of numbers; and notwithstanding the hardihood of the hunters, their hunting ground is so extensive, their paths are so difficult, and they are for great part of the year so inaccessible, that it is very probable they do little more (if as much) than capture those individuals which would otherwise perish from casualties.

The SAIGA (*A. colus*). Though this species must be considered as originally and properly Asiatic, yet it not only straggles in considerable numbers into those portions of the middle latitudes of Europe which may be said to have an Asiatic character, but remains in them all the year round, shifting its locality with the seasons. It frequents the arid plains or *steppes*, which, interrupted only by the valleys of the rivers, extend from the Danube to the Don; and it reaches eastward into Asia, as far as the same climate and character of land continue. Its food is the saline and other pungent plants which are found in these arid tracts; and it never resorts to the marshes, the woods, or the mountains. It is a true antelope, having none of the climbing habits of the goats, and none of their peculiar odour; but still, from the nature of its food, its flesh is unpalatable.

They have poves or follicles in the groin, lachrymal sinuses under the orbits of the eyes, and (the males only) have the horns round in their section, annulated, and spiral. The horns are semi-transparent, of an amber colour, and much esteemed in the arts. The size is about equal to that of the fallow deer, but the body is thick, bunchy, and not so compact. The head also is large, and the nose prominent and cartilaginous. The legs are long but disproportionally slender, considering the thickness of the body; and though the animal runs fast for a little distance, it soon loses wind, and is not difficult to capture. In the covering of its body, it is tempered to the plains which it inhabits, its hair being long and flowing, white on the under part, and yellowish grey on the upper in summer, but fading into dirty white in the winter. When the latter season begins to set in in the northern parts of their haunts, they assemble in numerous flocks, and migrate southward, and when spring returns they break into small parties and retrace their steps northward. The period of gestation is six months, and the kids are not dropped before the end of May, against which time the plants by the margins of the little streams on the steppes are in full verdure; so that, living dispersedly, they find plenty of food till their young are able to follow them on a wider range, when the saline plants appear, farther into the wilds. They are much hunted for their horns and skins, but their flesh is but little esteemed.

The antelopes of Asia and Africa are far more numerous than those of America and Europe; and as there are extensive regions in both those quarters of the world, yet in a great measure unexplored, it is probable that future observation may increase the number in both. On the confines of those two portions of the globe we may suppose that some of the antelopes will pass from the one to the other, and thus be the same in both; but in proportion as their principal localities lie farther apart, we may, from the climatal and other differences, conclude that the antelopes will not have exactly the same characters in both. This is the more likely from the different structures of their other animals. The elephants of the two are distinct species, having peculiar structural differences; and although the point has not been so well made out, it is probable that the lion also is not quite the same.

The CHIRU (*A. Hodgsonii*). This is a mountaineer, or, at all events, an upland inhabitant, though it prefers the wide plains to the forests or the rocks. Its native locality is on the elevated plains which stretch along the northern side of the Himalaya mountains, in Thibet, and probably in countries farther to the north; but it has not been found on the Indian side of the mountains. The plains which these animals inhabit are very peculiar in their character; for though they are near the perpetual snow on the loftiest mountain tops in the world, their climate is in general mild, though seasonally the snow storms are very violent. The animals of such regions, especially those that keep the open plains during the storms, have their covering adapted to ther locality. They have a coat of long and strong hair which throws off the snow, and a short and soft under garment of wool, which keeps them warm. This is the case with the chiru, which, though it comes further down in winter, braves the weather in the open plains all the year round.

The chirus have no lachrymal sinuses, no poves in the groin, and no knee tufts, and the females have no horns. They are rather large animals. From the muzzle to the horns measures nine inches, from thence to the tail four feet three, and the tail is about eight inches long. The height of the back is about three feet, and the animal stands nearly equally high on all its legs. The lips are hairy, the nose enlarged, with a knob on each side; and the horns of the male are about two feet long, lyrated in their curve, and annulated to within five or six inches of their points by about twenty projecting rings which are most prominent in front. The belly and inner surfaces of the legs are white, the fine wool over the body grayish-blue, the coarser hair fawn-coloured at the points, and bleaching to a paler shade in the winter. The face, the muzzle, and a streak down the front of each leg are dark brown or black. The females have only two teats, and they are understood to produce but one young one at a birth.

They are social at all seasons, living in considerable herds, being under leaders and posting sentinels like deer. If danger approaches, or an alarm is given by the sentinels, they make off with much speed; but if the males are so surrounded that they cannot retreat, they stand at bay, and defend themselves with great courage.

The COMMON ANTELOPE, or SASIN (*A. cervicapra*). This is another species which is properly Asiatic; and though it has been *said* to exist also in some parts of Africa, the fact has not been satisfactorily made out. Its principal locality is India, over the whole of which it is distributed in all places that are adapted to its habits. It shuns equally the desert, the forest, and the mountain, taking up its abode in the rocky plains, where it bounds along with great agility and grace. In its leaps, which appear to it mere play rather than exertion, it is said to rise at least twelve feet from the ground, and clear a horizontal distance of thirty feet.

And its form is as graceful as its bound is fleet. It is not a very large animal; but it is remarkable for the symmetry of its proportions and the liveliness of its expression: round and firm in the body, elegantly formed in the haunches, clean and elastic in the limbs, and bearing the head and neck with singular grace. Its length is about four feet, and its height to the back two and a half; the tail is about half a foot long and nearly naked; the ears are nearly the same length, narrow and pointed; and the forehead to the base of the horns is an inch more. The eyes are large, prominent, and bright; the lachrymal sinuses are much developed; and the horns are peculiarly elegant. In the mature males they are spiral, and a little divergent, closely ridged at their base, annulated in the middle, and smooth toward the points. Their average length in the full-grown animal is about a foot and a half, though in very old specimens they are often nearly two feet. Their size and also their spiral curvatures increase with the age of the animal.

Their colours vary considerably with age. When young, they are of a brownish ochre yellow on the upper part, with a narrow white band on the middle of each flank, and the muzzle, inside of the ears, breast, belly, part of the thighs, part of the buttocks, insides of the legs and cannons, except the knee tufts, which are brown, are also white. As they advance in age, the upper part of the face, the back, and outside of the ears, become rich deep brown; and the markings upon the flanks and other places black; and in some of the finest specimens the colours are almost wholly black and white. These dark-coloured ones are the patriarchs or champions of the race; and each of them has a small flock of females and younger males under his command and protection. The final change of colour takes place about the fifth year, and the females change as well as the males, but they never become darker than a tawny yellow, and are marked with a white streak along each side of the spine. The females have no horns; their time of gestation is nine months, and the produce is only one. When suckled, that one is said to be driven from the herd by the leader or patriarch, in which expatriated state it either falls a prey to enemies, or survives and becomes bold and courageous. This appears rather harsh schooling in a country abounding with beasts of prey as India does; but the antelopes defy the chace of most predatory animals, and their crouching and springing foes are chiefly in the jungles, and not in the ordinary haunts of the antelopes. The chutah, or hunting leopard, is sometimes used to catch them by springing, and they are also flown at by hawks; but their flesh is dry and not much esteemed.

The elegant form and graceful motions of the antelope have, however, found it a place in the Hindû mythology. That is not indeed much honour, considering that these people hold sacred, and build palaces for, animals which most nations find it their interest to destroy: but the antelope has particular honours: it enters into the zodiac as their capricorn, and particular rites are directed to be paid to it. These circumstances prove how early and forcibly it must have attracted the attention of mankind; and certainly, in so far as beauty is concerned, few animals are more worthy of attention.

The Thar (*A. Thar.*) This is also an Asiatic species, and inhabits between the localities of the two last mentioned. It inhabits the southern slopes of the Himalaya, not approaching the snows of those mountains or descending into the plains of India. The species has not hitherto been met with in any other part of the world, but it is plentiful in the region that has been mentioned; not living in herds, or even in small flocks, but solitary, except in the pairing season, and thickly scattered along the whole length of the mountain range. Animals which live solitary are often more easily killed or captured than those which are gregarious; and this is the case with the thar, which is more easily obtained than either the chiru or the common antelope. The gregarious ones keep sentinels always on the watch, whether the majority of the herd are feeding or reposing, and these give the alarm; but as the solitary animal has none to watch for it at such times, it is more easily surprised.

These animals are peculiar in their structure as well as their habits. Both sexes have short horns, slightly curved backward, channelled in their length, and furrowed across. They have the lachrymal sinuses of the true antelopes; but they have no knee bouches or bones in the groin; their muzzles are destitute of hair, and the females have four teats. The make is heavy, and the limbs thick, so that the animal is but a slow walker, and is soon run down upon level ground. The rugged places are its proper haunts, and among these it is quite at home, leaping and bounding along with ease and safety, where few animals can follow it.

The Dzeren (*A. gutturoso*). This is another Asiatic species, inhabiting the wilds of the middle latitudes in that part of the world, and called by the Chinese the "yellow goat." It is about four feet and a half in length, and stands about two and a half high at the shoulder. The body is thick and fleshy, the legs rather short and stout, the horns lyrated, annulated, and of a black colour; the lachrymal sinuses are small; and in the male the larynx is very much enlarged, and forms a prominent lump on the throat, from which the animal gets the name of gutturoso. In the female that enlargement and the horns are wanting. The female has but two teats. The colour of the under part is white at all seasons, and so is the upper part during the winter, but in summer that part is grayish-yellow.

Though far from being the most elegant of the tribe, there are many interesting points about the species. They are not only social among themselves, but they seek the society of other animals, and join domestic herds very readily. They are orderly in their motions, and always advance or retreat in line. They are remarkably fleet and sure-footed, and contrive to find food where few other animals could subsist. Those rocky deserts in the west of China, and between that country and the central mountains, which the continued action of the weather has reduced in great part to sand, or rocks quickly mouldering into that substance, and on which the few patches of vegetation that do occur can hardly be seen by the traveller, are its pastures; and such is its fleetness and inexhaustible vigour, that it appears to fare as well in these wild places as the common ox does in the richest pastures. The females bring forth about midsummer.

The dzeren appears to border on its western confines with the saiga, and to be found wherever the general character of the country becomes too wild and fatiguing for the latter. It probably also meets the chiru on the south of the central wilds; and thus, in so far as our present information extends, it appears to be the peculiar ruminating animal of a singular district, of which we have very little modern knowledge, or indeed knowledge of any kind, upon which we can depend. In the central ridges, however, which give rise to the Indus and the great rivers of China, there may be other species more adapted to rocks and precipices; for, from the volume of waters which some of these rivers (especially the Indus) roll along, at the highest points to which their courses have been explored, we may conclude that somewhere in those unknown central parts of Asia, there must fall much rain, and vegetation must be proportionally luxuriant. The antelopes are, in a geographical point of view, perhaps the most important of all animals; and if as much attention were paid to the *habits* of the migrant species, as has been paid to specific characters which have no application, and consequently no meaning, they might probably have, ere now, in so far been made keys to the unexplored parts both of Asia and of Africa.

The Chickara (*A. quadricornis*). This species, as its trivial names implies, has four horns. It is an Asiatic, and an inhabitant of India; but its appearance. habits, and haunts, are very different from any of those which have been hitherto described. These have all been tenants of the plain, the rock, or the mountains, but the chickara is an inhabitant of the forests. Forest ruminantia, as well as those which reside chiefly among ravines and small broken rocks, where there is no breadth of pasturage, live solitary, or at most in pairs, and the males are monogamous. In such situations they cannot, of course, keep watch; and as their enemies are more numerous and can attack with more certainty than in the plains, a numerous herd browsing near each other in the jungle, would be but the means of betraying each other to the tigers. Accordingly, this species, which is comparatively small and feeble, as well as the next to be mentioned, which is one of the largest, boldest, and most powerful of the tribe, always live apart from each other.

Four-horned Antelope.

The chickara is common in most of the wooded parts of India; its whole length is about three feet two, of which the tail occupies five inches, and the head seven inches and a half. The height is about one foot nine; the first pair of horns, which rise between the orbits of the eyes, are about three quarters of an inch long; the second pair, which rise immediately above the first, are three inches long, and straight, but inclining outwards and a little forward, and all the four are black and smooth, without any channeling or annular markings. The females have no horns. The colours are, bright bay on the upper part, silvery white on the under, and the lips black. The young males are like the females, of which the colour on the upper part is considerably paler. They are wild and restless animals, and impatient of confinement unless taken very young. The male in the pairing season is very pugnacious.

The Nyl-ghau (*A. picta*). The name *picta* (painted) is not very descriptive of this species, as the only peculiar appearance of painting about it are some white spots on the pastern joints. This species is, like the former, an inhabitant of the Indian forests; but it frequents richer places, more closely adjoining the cultivated grounds, and not unfrequently, in the cool of the mornings and evenings, approaches the plantations, and levies contributions on the crops of the cultivators. It is a large animal, standing more than four feet at the shoulders, though less elevated at the croup. The shoulders appear to be elevated by a hump, owing to the produced processes of the vertebræ at that part of the spine. The body is strongly made rather than handsome, and the limbs have a slight resemblance to those of a poney. The hoofs are much longer and flatter on the under parts than in most of the species, indicating that the animal is fitted for walking upon softer ground. The neck is compressed laterally, and furnished with a rudimental mane, which extends as far as the hump on the shoulders; and on the lower part of the neck there is a pendent tuft of long and shaggy hair. The tail is moderately long, rather flattened, and covered with short hair except at the point, where there is a brush. The face is long and straight in the outline; the muzzle large and naked; the lachrymal sinuses much developed, the ears long, broad, and rounded. The horns are scarcely longer than the ears; they are smooth, angular at the bases, tapering, sharp at the tips, and very formidable for their size. Excepting the mane and the tufts on the throat and tail, the hair all over the body is short, smooth, and close. The under parts of both sexes are white; the upper parts of the males are usually of a dull grayish-blue, and those of the females tawny; but the colours are subject to considerable variations. The bluish colour is that of the mature male, the young male being of the tint of the female. The nyl-ghau will breed in confinement, and the females are gentle animals, but the males are vicious, and, in the season, it is dangerous to approach them. Their mode of attack is both singular and formidable; they crouch on their fore-knees, bring their hind and fore feet together, and then dart forward with great velocity, delivering their whole impetus upon the horns. The force would be sufficient to transfix even the tiger; and it is probable that no beast of prey will attack the nyl-ghau openly. But tigers, and even leopards, often leap upon them from their covert, and then easily despatch them; so that in the neighbourhood of the jungles nyl-ghaus form a staple article of the tigers' food. The female goes eight months with young, and generally produces two.

The Ahu (*A. subgutturoso*). This species is described as inhabiting the middle latitudes of western Asia, from the mountainous or semi-desert parts of Asia Minor, by the north of Persia, and through Bukharia, toward Daouria, and on the north bordering with the saiga. In its character and habits it has a very considerable resemblance to the gazelle which inhabits north of the African desert; and as the Isthmus of Suez is the point at which the wild parts of Africa and Asia run into each other both geographically and physically, on that account it is natural to expect that many of their productions, even their characteristic ones, should be specifically the same, though, of course, with climatal differences or varieties increasing as the physical circumstances of the countries differ more and more from each other.

For these reasons, but chiefly because, excepting in the locality they are found, they present no very remarkable differences that can be made the foundation of popular descriptions, we shall refer at least all the northern varieties of what is sometimes termed the gazelline group to the gazelle itself. The chief of these are, the Kalseepee, "black tail" (*A. Bennettii*), of the rocky parts of southern India, which is formed like the gazelle, only a little longer on the legs; the Ariel (*A. Arabica*), seen in the southern parts of Arabia, generally like the gazelle, only more elegant and darker in the colour; the Abu, and perhaps a few more. The Kevel (*A. Kevella*) should, perhaps, be included; but as it is found in Senegal, south of the great desert, that may seem to involve a little difficulty. The difficulty in a great measure vanishes when we consider that in ancient times there was fertile land all the way from the mouth of the Nile to Senegal, without any known interruption of more than a few hours' march for a gazelle; and that, in the parts of the line which have now become barren, the gazelle is among the animals most frequently sculptured upon the ancient monuments. That gazelles should migrate when the countries over which they pass are in progress toward the desert state, is neither improbable nor unlikely. When the desert begins to be formed, the surface, and of course the vegetation upon it, becomes saline; all the antelopes are fond of salt, which seems to be one of the chief inducements which draws them to desert places. The chamois hunters know that they will find their game where the rocks are saline, or salt water oozes out of the ground; and the antelopes in India lick the efflorescence of saltpetre, with which the naked soil there is often covered.

The Cambing Outang (*A. Sumatrensis*), is a native of the island of Sumatra, is called the wild goat there, lives on the rocky mountains, and has many of the habits of the goats. It is about four feet and a half in length, and half the same in height to the shoulder; the back is a little rounded, but, as is the case with all the mountaineers, it stands nearly equal on all the legs; the forehead is straight, the muzzle well formed, the ears are of moderate length, the horns about six inches, stout at their bases, but tapering to the points, and slightly curved backwards. The body is stout, the legs muscular, and the hoofs rather large. The hair is long, generally of a blackish brown colour; but white on the nape, and partially on the shoulders, and the insides of the ears; and straw-coloured on the chin. They are said to live in small flocks, and to be very shy and difficult to come at.

Those which have been slightly noticed are all the leading, and indeed all the well-established, species of antelopes in America, Europe, and Asia. It is not improbable that there may be other species in them all, except Europe; and indeed other species have been named and described; but as that has been done from fragments, and sometimes from small and mutilated fragments, and as the living animals are not known, they do not at present belong to popular natural history.

It now only remains, therefore, to take some notice of the antelopes of Africa, which may be regarded as the grand home and head quarters of the tribe; and were we in possession of data, by means of which we could trace and follow them in all their varieties and migrations, from the shores of the Mediterranean to the Cape of Good Hope; and from Cape Guardafui on the east to Cape Verd on the west, we should no doubt find the antelopes of Africa, with their accompanying animals, and other associated circumstances, one of the brightest as well as the most instructive pages in the book of natural history.

The subject, (though much has been attempted and done of late years,) is one which we know only at a few points. But we know enough to convince us how interesting the whole must be, and also to give us the hope that the channels of general knowledge may soon be opened through that wide and wonderful country. The termination of the Niger, the proximity of some of its branches to those of the Nile, and of its sources to those of the Senegal and the Gambia, render it not unreasonable to conclude that ere very long navigations may be opened from Alexandria to the Gulf of Guinea and to Senegambia; and when this is accomplished, we shall be able to take the lion in his den, and give the whole wealth of Africa, scientific and possessional, to civilisation and enjoyment; and for the mutual benefit of the people of Africa, and of all the other parts of the world, of which Africa forms the centre, and should be the point of connexion. At present we can only "hope and inquire on;" and it is cheering to reflect that the field is rich and ample; and that they who observe the details on the spot, and they who generalise those details, are equally, though in different ways, speeding the grand result.

Antelopes are not the only ruminantia of Africa; but they are by far the most numerous both in species and in individuals. They are not now so numerous in the colony at the Cape, or upon its confines, as they are represented to have been in former times, when swarms of lions toiled in vain to keep down their numbers; and the depredations committed by the prey were more formidable in the eyes of the more distant settlers than the power and ferocity of the preyer. Still they are very numerous, and many of them flit *en masse* from where the drought parches to where the rain brings vegetation; and from what has already been said of the habits of antelopes, it will be borne in mind that those which congregate in such numbers, must, at all points and stages of their migrations, be inhabitants of the plains; for animals do not change their habits when they migrate, they migrate because they cannot change them. Here, therefore, is one point in African geography, as clearly demonstrated as if eye-witnesses had been on the spot. "There are, throughout a great range of latitude in central Africa, plains which are capable of supporting countless millions of grazing animals,—numbers, in short, vastly greater than we know or ever heard of in a state of nature, in any other region of the globe." It, in fact, resembles the fertility of the sea more than the comparative sterility of the rest of the land: the antelopes, and some accompanying animals, arrive like shoals of herrings; and the lions follow, as the predatory fishes do those shoals, and appear not to make much more impression. The conclusion is irresistible: "There must be in central Africa immense tracts of land, which would better repay skilful culture than any other land on the face of the globe." The "passenger pigeons" of North America, though probably more numerous, though not so extended in their part, are not a parallel case; they only prove the vast abundance of wild berries; and where these are superabundant, the land is never either the most kindly for grazing, or the most valuable under the plough.

This instance is given to show the reader, who is not accustomed to reflect upon such matters, the vast importance, in an economical sense, of clear and comprehensive views in natural history. The notices of the African antelopes must be mere matters of detail, for to that only the information reaches; and, in many instances, it is most imperfect even there.

The Gazelle (*A. dorcas*). This is rather a small, but a very beautiful species, and one which has been long known, and much celebrated. Its principal locality at present is the north of Africa, between the cultivated country along the shore of the Mediterranean and on the banks of the Nile, and the Great Desert; but it has been already noticed, that other species are probably only climatal varieties of this one. The specific name *dorcas*, literally means "bright-eye;" and we accordingly find that, in the poetry of the Arabs and its imitations, the eye of the gazelle is the type and standard of beauty in that organ; and, it must be admitted, that the comparison is much finer than any of those in which inanimate substances are introduced as expressive of the lustre of eyes. But the name has other meanings, and alludes to the keen sight of the animal, and also to its darting along like a thrown spear or djerrid.

The gazelle is a very beautiful animal, the most gracefully formed of all the antelopes, indeed of all the mammalia. It is light and slender, and yet its structure is such as to indicate the very maximum of agility and strength which can exist in the same weight of body. In form it is the beau ideal of a deer, bearing about the same relation to the finest roebuck as the Belvidere Apollo does to man. If any of its proportions had been thicker, the impression would have been that it had weight to carry; and if thinner, that it was liable to fatigue. But so perfectly is the gazelle formed, that it gives no impression either of burden or of fatigue. Imagination cannot limit the extent of its bound, or the number of them that it can take in succession.

It is rather less than a roebuck, being about three feet and a half in length, one foot nine at the shoulder, and a little higher at the croup. The head and neck are beautifully formed; the forehead slightly rounded; the eyes large, prominent, dark, and expressive; the muzzle rather slender; the ears long, narrow, and pointed; the horns between nine and ten inches long, gently rounded and lyrated. They are much annulated at their bases, but the annuli disappear on the posterior surfaces about the middle of the length, and a portion at the tips is quite plain. The females are provided with horns as well as the males; but in them they are smaller, and hence some of those who have followed the trade (rather a common one with regard to this race of animals) of manufacturing an antelope out of a pair of horns, have made a species of the female gazelle, and called it *corinne*, and other names. With the exception of the knee tufts, and the tail, which is covered with stiff black hair, and ends in a brush, the whole covering of the gazelle is close and smooth; the anterior part of the head is a reddish fawn-colour, with a dark-brown streak on the nose, and a white one downwards from the root of each horn, over the eye, and along the side of the face. The contrast of these last gives peculiar brilliancy to the dark eyes. The general colour of the upper part is dun, that of the under white, and the two colours are separated by marginal belts of brown, more or less conspicuous. The tints of colour are, however, subject to much difference, both in different individuals, and in the same individual at different ages; so that, in this species particularly, colour cannot be made a character.

Gazelles keep the open plains, and browse upon the saline and other pungent plants which they meet with there. They are gregarious, living in considerable herds; placing sentinels when they graze, and bounding off apparently in different directions when an alarm is given, but making for a more commanding ground, and forming a square there, with the females and young in the centre, and the bucks outside on the defensive. The lion and even the panther will, however, attack these squares, crouching forward till within his distance, and then springing upon one with certain aim, upon which the others move off. It is when they resort to the water, however, which is generally in the morning, that antelopes generally, and gazelles among the rest, suffer most from the ravages of beasts of prey. The gazelle is the species which, geographically at least, connects the antelopes of Asia and Africa.

The Addax (*A. addax*) may be said to inhabit between the gazelle and the African deserts, and probably to follow that line of country through all its bendings and irregularities; the country near the sources of the Nile appears indeed to be a sort of centre, at which antelopes from the different parts of Africa meet, and possibly form hybrids; so that single specimens, and especially fragments, from that part of the world, should be received with the greatest caution.

Addax.

In point of locality the addax bears nearly the same relation to the gazelle in Africa as the common antelope does in Asia to those species which we have said may perhaps be considered as climatal varieties of the gazelle; and it is not a little curious, that the addax resembles the common antelope in many of its external characters, though it is larger in size, and differs from it in other particulars. It stands three feet seven inches at the shoulders, and an inch or two more at the croup. Its aspect is fleet and vigorous; its horns are large, spiral, and much annulated. They stand rather wider at the base, and are not quite so thick at the base in proportion to their length; but still they might readily bo mistaken for those of the Indian antelopes. The addax, however, has a tuft on the throat, immediately below the chin; the tail is much more produced, naked for the greater part of its length, and ending in a bunch. The outline of the buttock is also less rounded, and the insertion of the tail is farther down: it is, as one would say, "droop-rumped." The most remarkable difference is in the habit. The common antelope is gregarious, and the old males are rulers. The addax, on the other hand, lives solitary, or in pairs, and the males do not appear to interfere with each other. This agrees with the character of the localities in which the addax is understood chiefly to reside. These are not arid plains, half desert all over, but still having a breadth of vegetation, such as it is, upon which a herd can browse. They are little patches in the desert; and where these have supply enough of water to resist being changed into sand, they are usually covered with thickets of some sort or other. Thus the addax has, in part at least, the solitary habit of the bush antelopes, rather than the social one of those of the plains. The hoofs of this species are much broader than those of the majority of antelopes, which enables it to move more easily over the loose sands which often lie between its pastures. The general colour of the addax is grayish-white; the head and neck reddish-brown, with a white bar on the forehead, and some black round the bases of the horns.

It is on the south and south-east margins of the desert chiefly that the addax is found; and as these places come within the action of the periodical rains, it follows, almost as a matter of course, that the addax, and all the antelopes which inhabit there, must be migrants. Every one knows that the surface of naked sand must be hotter than that which is covered by any sort of vegetable; and that therefore the natural current of the air must be toward the desert. That current always carries with it germs of life of some sort or other, and when it blows a wind it can carry the seeds of moderately large vegetables. There is thus, therefore, a constant sowing of the desert; and if but one week of heavy rain fall upon it, Sahara itself cannot maintain its sterility. The rains on its margin are heavy and of some continuance; and therefore when these fall the fertile land invades the desert for many miles: and after the rain has ceased, and all the moisture is evaporated, the desert resumes its sway. These alternations play backwards and forwards every year, and over greater or smaller spaces, according to the annual proportions of wet and drought, which vary, of course, as they do in all countries. A season of great drought may thus send the antelopes of the desert's margin to Abyssinia, on the one hand, or to Senegal or the coast of Guinea, on the other; and a season of uncommon humidity may keep them in the interior. We cannot, therefore, say distinctly that they inhabit any particular locality, for they inhabit according to the season. This is another point in the natural history of central Africa which is well worthy of attention.

The Abu-harb (*A. leucoryx*) is the next south-eastern neighbour of the addax. It is, in all probability, the oryx of the ancients, and may (indeed must) in their days have been much more widely distributed than it is now. It is said still to exist not only in that part of Africa which lies opposite the south of Arabia, but in the latter country, and in Persia, as far as the Indies, being, in all its localities, the southern neighbour of the gazelle and its varieties. The data are not complete enough for certainty; but this is probable, as the *isothermal* line does *tend* in that direction; and it is all, partially at least, within the action of the rains. In former times it must, from the extent of plain which has been converted into desert, have extended much farther, and it is not possible to suppose that any one acquainted with Egypt could have been ignorant of it. It is a gregarious animal, and an inhabitant of the plains; but it browses on the leaves of trees, principally those of the acacias, and not the saline plants, like the gazelle; and therefore when, in its progress towards the desert, the country came to produce only gazelle's food, the abu-harb (the *oryx*) must have departed or perished. As its general habits resemble those of the gazelle, it is highly probable that there are, as in that animal, many climatal varieties; and that what have been sometimes described as different species are the same. It must not be forgotten that, as the progress of cultivation has broken the domesticated ruminantia of Europe into many varieties, the progress towards desolation has done the same with the wild ruminantia of the districts under notice.

Oryx.

This species is about the same size as the addax, but rather stouter in the body, and having the hoofs narrower, and not so well fitted for walking over loose sand. The general colour is white, variously marked with black on the forehead and brush in which the tail terminates, with brown on the legs, and with rust-colour between the brown and white. The horns are long, slender, and very slightly bent from the curve of the forehead throughout their length. This is the animal, the profile of which with the horns seen as one, is supposed to have suggested the notion of the fabled unicorn; and the robust make, the long tail with a brush, the mane, though that is much exaggerated, and all the characters of the animal, give some probability to a conjecture which can neither be established nor refuted. The animal which has been described as the Algazel (*A. Algazella*) is a mere variety of this one, and from the same regions—that is, from the south-east or south of the Great Desert; and till we know something of the country immediately to the south, and of the species and habits of the ruminantia there, any information which rests upon a single specimen, of which the general native habitat is not known, must be received with caution.

The Bekr-el-wash (*A. Bubalus*). This is another species of the margin of the desert, inhabiting perhaps nearer to the cultivated lands than those which have been already described. There is a slight trace of resemblance to the ox tribe in the abu-harb and the algazel, and the likeness is still more decided in the present species, which, for that reason, gets its Arabic name of Bekr-el-wash, or the "wild cow." The general air of the head, and the shape of the muzzle, ears, and horns, is bovine; but the horns are annulated to within a short distance of their points. The neck, shoulders, and outline of the croup are also modelled like those of the ox, and there is a sort of rudimental dew-lap between the fore-legs; but the animal is more clean and compact in the body, and the legs are larger in proportion. The proper locality of this species appears to be to the north of the Great Desert, but, like the other inhabitants of the plains bordering upon that, it appears to have been much more numerous in former times than at present.

Though several of the more delicately formed antelopes which are met with in the countries about the sources of the Nile, are probably varieties of the gazelle, yet there are others, which, though they have some analogy to that species, have very marked differences.

Sœmmering's Antelope. (*A. Sœmmeringii*) is a very beautiful species from the eastern parts of Abyssinia. They live in pairs upon the low hills, and partially in the bushes, so that their habit does not agree with that of the gazelles. They have very long and slender limbs; their necks, heads, bodies, ears, and, indeed, horns and tails are so light and slender as to give the impression of feebleness; and though there is an enlargement of the haunch, which indicates that they can leap with some alacrity, there is no indication of their being able to scour the open waste like the gazelle. The throat, belly, and insides of the thighs and legs are pure white, the whole of the upper part cream yellow, and the face variously marked with black, brown, and rust colour, but with a white stroke down each side, as in the gazelle, though in front of the eye rather than across it. The muzzle and crown are both narrow, which gives a lozenge shape to the face; the horns rise parallel and near each other at their bases, then they bend outwards till they are nearly horizontal, and again inwards at the points. They are annulated to near the points. The females have the horns rather smaller and smoother, but in other respects they are like the males in appearance. The hair upon the body is very short and glossy, and turned many ways, so that though really all one colour, the animal appears shaded in stripes.

It is possible that some of the small and lightly formed antelopes, of which menagerie or museum specimens have at different times been brought from the zone between the 10th and 15th degrees of north latitude in Africa, and which have never been seen in a state of nature, are varieties of the species now mentioned. There seems at least some probability of such being the case with those which have been called *A. forfex* and *A. adenota*. The shape and size of horns are, at all events, very unsafe grounds of distinction. It is true that the effect of climate upon the horns of ruminantia has been no more studied than its effect on their colour; but there *are* effects, even within small geographical limits; and they are so strong, that they suffice to distinguish the cattle and sheep of the different districts of Britain.

The Madoqua (*A. Saltiana*). This is a neighbour of the former, and is said to have nearly the same habits; but it is very different in size and in many of its appearances. It is not above two feet long; only fifteen or sixteen inches in height; its body, head, and neck are slender, and the cannon bones of the legs are hardly thicker than a goose-quill. The horns are slender, annulated, in the plane of the face with a very slight bend forward, and they are about three inches in length. Between them there is a pointed tuft of hair, about half their length, which at a distance has something the appearance of a third horn. The female has the tuft, but wants the horns.

This delicate little creature (certainly the smallest and by much the lightest of horned mammalia) is as beautiful in its colours as it is delicate in its form. The face, forehead, coronal tuft and legs are deep red, not so rich and glowing as many of the reds in the feathers of birds, but more so than in the hair of any other of the mammalia. The rest of the upper part to the haunches is squirrel-gray, or gray produced by alternate portions of bluish-black and white in the single hairs, excepting the middle of the back, which is reddish-brown. The posterior part of the haunches round the tail is white, the hair rather produced and radiating from the tail as a centre. All the rest of the under part is white. [In describing the under part of a quadruped, whether one of the mammalia or not, it is understood to mean the throat, breast, belly, and *insides* of the legs. The *outsides* of the legs belong to the upper part.]

There is still another antelope, differing with the locality, or there are two or three species of antelopes, agreeing in almost every thing except size and colour, and not differing more in these respects than some other varieties of the same species do, inhabiting the southern skirts of the great African desert, probably the whole way from the Red Sea to the Atlantic. These animals extending, as they do, over a range of nearly two thousand miles, may be supposed, even though identical in all their characters, to get different names in different places; and indeed, with the exception of those species which, from their resemblance to these animals are called wild oxen, or wild goats, it is probable that the names of all the gregarious antelopes on the borders of the desert, have the same meaning as "gazelle." The species in question is

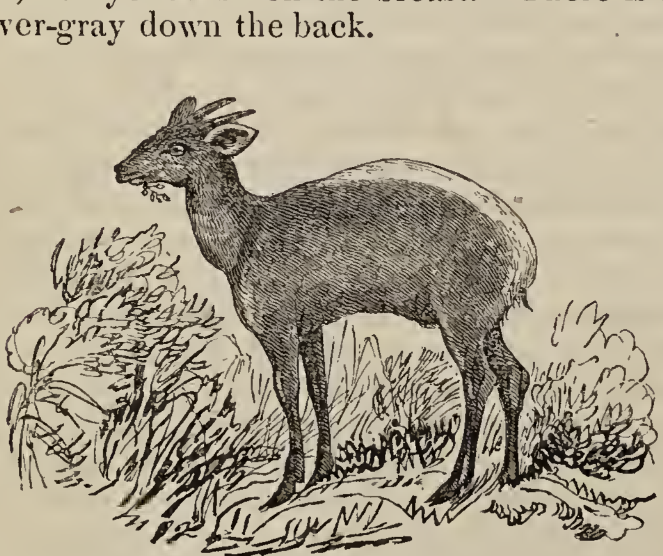
The Dama (*A. dama*), which certainly has been found of larger size and different in colour in the eastern part of the range than in the western. The former, found in Upper Egypt and Nubia, has been called Addra (*A. addra*); and the latter, from the country farther west M'horr (*A. m'horr*). There was indeed a third account anterior to these two, founded upon an immature specimen brought from Senegal by Adanson. These animals are gregarious in their habits, fleet in their motions, and firm and elegant in their shape. The legs are long; the neck long and curved, with a contrary flexure; and there is a white spot at the most prominent part of the curve on the throat. The horns are very peculiar; they are strong at their bases, inclined slightly back, and annulated; and in the remainder of their length are smooth, and recurved forward so as to form complete hooks.

The *m'horr* is about four feet in length, and stands about two feet and a half, the hind legs being a little longer than the fore ones. The length of the horns is about nine inches, including the hooks. The colour of the under part, from the neck to round the insertion of the tail, is white, and there is an oblique band of white across the hip. The head is bright fawn-colour, with some black hairs at the bases of the horns, more produced than the rest. The remainder of the upper part is of a rich reddish-brown.

The *addra* is fully a foot longer and half a foot higher than the *m'horr*. Its proportions and the form of its horns are exactly the same. It does not appear that there is more difference in the colours than is to be met with in the gazelle and in other species. There does not appear to be half the difference between the two, which may be seen in the cattle of the uplands and lowlands of any county in England, having considerable diversity of surface.

The Koba, or Kob (*A. Koba*), is another species, or probably two species, inhabiting to the westward of the former, in the interior of the country upon the Senegal and Gambia. One, the *Grande vache brune* of the French settlers in that part of Africa, is known as a menagerie animal; but of the other, which the same settlers call the *Petite vache brune*, we have not even that knowledge; and we know little or nothing of the *natural* history of the first. The "great brown cow" (*koba*) is almost five feet long; the head is long, the ears long, the horns are said to be twenty inches long, annulated and lyrated. The legs are shorter than in most of the antelopes, and stout. The hair on the body is shaggy. The general colour on the upper part of the body is dull purplish-red, the face and legs (which have the hair shorter) dark brown; the nose, and a streak in front of each eye, white. Its manners and mode of living are unknown. Analogy would lead us to suppose that it lives in the small fertile plains which alternate with wood and bush, and that it is not much of a migrant.

The Bush Antelope (*A. sylvicultrix*), is found in the woods or bushes in the vicinity of Sierra Leone, and by the English residents there called "bush goat." It is a dull heavy animal, lurking in the thickets during the day, and resorting to the open spaces in the mornings to feed. Its back is arched, its legs short, and it has altogether a "pig-like" shape; but its flesh is much better than that of the more handsome antelopes. The length is about five feet, and the height three. The horns are not longer than the ears, nearly straight, divergent, and slightly turned back. The hair is smooth and glossy, dark brown on the back, paler on the neck and flanks, gray on the thighs, and yellowish on the breast. There is a line of silver-gray down the back.



The Bush Antelope.

The Guib (*A. scripta*). This is another species of Western Africa, and, from the little that is known of it, it appears to inhabit still nearer the coast than the former; and, by inference, in pastures still more broken by wood and brush. The guib is of the mean dimensions, or four feet and a half in total length, and two and a half high at the shoulders, but rather higher at the croup. The horns are straight, but wreathed with two prominent ridges in the form of a double screw, prominent at the base, but becoming obliterated near the tip. The general colours are fawn and white variously marked. In general, the head is reddish-fawn, with a darker spot on the forehead, and three white spots on each side of the face, diverging from the bases of the horns, so that one is in front of the eye, the next under it, and the last farther back on the cheek. The fawn colour on the neck and body is darkest in the middle, becomes paler as it descends, and on the breast ends in white. The ridge of the back is marked with a longitudinal stripe of white and black mixed. From this, a greater or smaller number of white streaks pass herring-bone ways backwards and downwards, and they are crossed by longitudinal ones of the same colour, nearly parallel to the ridge of the back. The parts which these stripes do not reach are marked with white spots. The insides of the legs are white; but excepting part of the breast, the rest of the under side is brown. Both sexes have these markings; but it would be contrary to our experience in the case of all other animals to suppose that, when the colours are so much broken, there should not be great differences between one individual and another.

The writer of this article once saw a stuffed skin of a very small specimen from that part of Africa. It was without horns, had the shape and general colours of the guib, but it was dappled with white spots on the fawn-colour, not above twenty inches long, and small in proportion in all its other dimensions. As there was merely the skin, it is impossible to say whether it was a young guib or some other species. The probability is that it was a specimen of the guevi, or huebi (*A. pygmæa*), of which there are certainly varieties differing much in size. As is the case in Abyssinia at the eastern part of the line, these small antelopes of Senegal appear to keep much more in the hilly grounds than the larger ones; and if the accounts can be relied on, they are as numerous in some places as hares in a preserve. The place wants thoroughly exploring however, and for various reasons, physical and others, that is no easy or safe matter.

The guibs associate in small flocks, in the openings of the woods near the larger rivers; and they are, of course, not migratory to any distant part of the country. Indeed, the discovery of the course and termination of the Niger, has taken the district which it and the Senegal circumscribe, and also as much of the country on the outside as their influence keeps in a state of continual verdure, out of the range of those general causes which may affect the rest of the continent. This portion of Africa, which may, as respects the rest of the continent, be regarded as peninsular, is of a lozenge form, extending on the average about 1500 miles from east to west, and half as much from north to south. This large and important tract has its own central mountains, from which streams descend in all directions. There is to be sure, a summit level or "water shed" inosculating with the desert toward the north, between the sources of the Senegal and those of the Niger; but the sources of the most northerly branch of the Senegal, which flows parallel to the line of the desert, are understood not to be twenty miles distant from the Niger, after it has descended from the mountains, and is flowing slowly through the plains of Nigritia. Therefore, the migration of any animals, except birds, must be very limited in this district, and must be confined to the seasonal movement of the tribes in the northern parts into the desert and back again. The great body of its mammalia must be resident; from its productiveness, arising from the hottest climate and plenty of rain, they must be numerous; and the probability is, that antelopes are the most numerous of all, and that many new species and varieties may yet be discovered. As in this part of Africa the grasses are too coarse and reed-like for the food of the ox-tribe, and in the dry season, they in many places wither, and the remaining verdure is too much scattered for these comparatively slow-moving animals, antelopes and other swift and light-made, or long-limbed creatures, which can bound rapidly from place to place, or leap up and seize the pendent foliage of acacias and other trees, which retain their verdure in the severest drought, are much better suited to the country. Africa is thus, in an eminent degree, the land of antelopes; and the natural history of these animals, if complete, would be a key to much of the natural history of Africa.

When however we approach within about five degrees of the equator, our knowledge of the interior wholly fails, and even the coasts are known at particular points only; so that we can no longer make the country and the animals reciprocally illustrate each other, but must confine ourselves to detached notices of the individuals at those places where they are found. It is worthy of notice, however, that though there are in Southern Africa antelopes resembling all or most of the species of the north and the centre, there are none which can be regarded as exactly the same species; and there are some to which no nearly-approximating types have been found in any other part of the world. It is different with some of the other ruminantia; the *giraffe*, for instance, is the very same from Senegal to the most southerly point at which it occurs.

The known species which are first met with in our progress southward, form a distinct group. They are of large size, bold and courageous, inhabit rich pastures, and do not associate in large flocks, or migrate, at least to great distances. The first of these is,—

STEEDMAN'S ANTELOPE (*A. ellipsiprymnus*). (See plate "Antelopes.") This is a large and handsome species, and the most northerly one known inhabiting Southern Africa. The specimen from which our figure is taken, and which is the only one which has yet come to Europe, was obtained near the west coast, and to the northward of Orange River, in about twenty-eight degrees south latitude. The dimensions are seven feet three from the muzzle to the insertion of the tail; the tail to the extremity of the hair, one foot nine; height at the shoulder, three feet ten; at the croup, two inches less; length of the horns along the curve, three feet and a half. It is said that specimens considerably larger occur in the district from which the one in question was obtained, and that they are daring and even ferocious animals, which, excepting in cases of surprise, defy both the native hunter and the lion. The prevailing colour is rusty brown and grey, the brown nearly entire on the back and the lower parts of the legs. The face deep blackish-brown. The interior of the ears, the lips, a streak down each side of the upper part of the face, and an obscure band on the throat, immediately under the jaw, are white. There is also an ellipse of white, very conspicuous and well-defined, passing from the croup across the hips, and meeting below. This mark is equally well-defined and striking. The hair is not very long, but coarse and in clotted tufts, turning in all directions from a whirl on the middle of the loins, and reversed on the anterior part of the body, under as well as upper. The hair on the neck is also clotted, but there is no produced mane or beard. The horns are very strong as well as long; they rise in the line of the forehead, and gradually bend outwards and forwards, but not to any great extent of curvature, and they incline inwards at the tips. For two feet next the base they are annulated, the annuli prominent and distinct, twenty-four in number. The annulated part is also striated longitudinally, and of a light brown colour. The six inches at the points, which are smooth, are black. The section is not round, but has a groove, becoming gradually obliterated toward the points; and contrary to what appears in many other species, the groove is in front. All the characters are expressive of great energy and strength, and, in its native wilds, this antelope must be a noble creature, seen at a safe distance.

The EQUINE ANTELOPE (*A. equina*) inhabits nearly the same places as the last-mentioned species, though perhaps a little nearer to the sources of the rivers. At all events it has been more frequently seen. Its habits appear to be similar, living in pairs or very small flocks, keeping near the perennial streams, and not migrating. It is nearly of the same size, but is not quite so compact in the body, and has more elevation in the shoulders. The horns are not quite so long, and they are thicker, more closely annulated, and curved backwards. The ears are longer, narrower, and more pointed; the hair also is different both in colour and in texture. It is long, open, of a mixture of reddish and grey on the upper parts, and chestnut on the face and outsides of the ears, but variously mixed and marked with white. There is a white patch round each eye, ending in a streak downwards at the anterior angle; a short round white mane on the neck, a white fringe along the throat, and the belly is white. It seems subject to varieties both in colour and in size.

The TAKHAITZE (*A. barbata*) inhabits nearly the same places, but still more mountain-ward than the former. It is not quite so large, but remarkably fleet and daring. It has a long beard and mane. This species do not flock, but alternate between the small open places and the thickets on the hills, feeding upon the leaves of the acacia. Their manners are not very much known, but the natives say it is dangerous to attack them.

The BLAUBOK, "blue buck," (*A. leucophæa*,) is another species agreeing in several particulars with the three last mentioned, but smaller in size, inhabiting still nearer the sources of the streams, and being more discursive in its range, though not gregarious, or, strictly speaking, migratory. It is six feet in length, three feet and a half high to the back, and very compactly made. The horns are more than two feet in length, round, closely annulated to within six inches of the tips, bent back in a uniform but moderate curve, and very sharp at the points. The general colour of the hair is grey, with the insides of the ears, a streak before each eye, the insides of the legs, and a few hairs along the ridge of the neck, white. The hair on the body divides on the line of the back, and is rather coarse and open. The skin under it on the upper part of the living animal, is a black, which, shining through the grey, produces a sort of raven-blue tint. It is the epidermis only and not the mucous tissue which has this black colour, otherwise the hair would have it; and it fades when the animal is dead, as is the case with a highly-coloured epidermis in almost all animals. This species was, in former times, met with as a rare straggler within the limits of the colony at the Cape of Good Hope, but it has not been seen there for many years, and indeed it appears to be of even more rare occurrence than the former three species, of which the discovery is much more recent. All these antelopes appear to be peculiar to the Orange or Gareep river, which flows westward through the greater part of the breadth of the continent, about latitude twenty-eight degrees south.

The Springbok (*A. euchore*). This is the species which, in Southern Africa, corresponds to the gazelle of the north, and it is by far the more abundant and more beautiful animal of the two. In size it is about one-third larger than the gazelle, and it is more symmetrical than even that singularly graceful animal; so that if it had belonged to the country of the Arabs instead of that of the Hottentots, there is no question that the springbok would have been the most poetical of animals. Its colouring is equally fine in gloss and in tint. The general colour on the upper part is a delicate cinnamon-brown, and that on the under part pure white, and on the flanks these two are separated by well-defined bands of venous red. The head, face, cheeks, and chin are white, with a brown band on each side from the eyes to the corner of the mouth, and a mark of the same colour, beginning in a small point over the muzzle, and gradually widening, till it merges in the general

The Springbok.

colour of the upper part. At the loins there begin two duplicatures or folds of the skin, which run parallel to each other to the insertion of the tail. These folds are lined with long hair of the most delicate whiteness, and the animal displays or conceals that hair at pleasure. When the animal is in a state of repose, the folds are close, and nothing but the cinnamon-colour appears; but when it bounds and leaps, they open and the display of white has a very singular appearance. The horns of the springbok are black, round, finely annulated for about half their length, lyrated with bold flexures, and altogether very handsome. Both sexes have horns, though those of the female are smaller: in fact, their general characters are very similar to those of the gazelle. They, however, associate in much more numerous herds, are far more migrant, and do not form into such regular squares for their defence; and although their forward motions are perhaps not more fleet, their upward leaps are more conspicuous.

As they are the most beautiful antelopes of Southern Africa, so also are they the most numerous, though, as is the case with all the species, they are not now so numerous within the Colony as they were formerly. Indeed, so indefatigable do the colonists appear to have been in destroying every production of wild nature that when the country became a province of science, it was in a great measure one of ruins and memorials; and it does not appear that the climate or the fertility is at all improved by these labours of extirpation.

Springboks are migrants over an unknown range of country, flitting with the monsoons, and when they do so, flitting *en masse*. Formerly the numbers that appeared in the colony when the rains brought vegetation upon the open plains or *karroos*, are represented as having been immense; and they still come to the northern parts in very large flocks, though not regularly, every year. Where they come they clear every green thing before them; and it is said that on their marches, those in advance are fat, and those in the rear lean; and when they turn and move back in the opposite direction, the lean ones fatten and the fat ones fall off. This however is not the way in which browsing animals usually pass over an extensive pasture: as they feed themselves full they linger, and others get a-head of them. When herds of animals scour a pasture, they proceed in a manner somewhat different from this, and one of which some idea may be formed by any one who has seen a numerous flock of dottrels scouring the downs in the autumn, or of flocking birds ranging a stubble field in winter. The birds, no doubt, have the advantage of the wing, and so can come at once from the rear to the front; and when the pasture is an unproductive one, the whole roll along like a hollow cylinder. Grazing animals cannot, of course, change their place in the column so rapidly, but antelopes, especially the karroo-ranging antelopes, are very fleet animals, and in leaping over those in advance the springboks are perhaps the fleetest of any. As those that are in front begin to get full they linger, and the others get a head of them, partly by walking and partly by leaping. All grazing animals follow a course nearly similar. The front rank, or even fifty ranks, do not eat the pasture bare; they take but a mouthful or two and pass on. This may be seen in the case of a single cow (which is one of the slowest animals that are gregarious when they graze) when she breaks into the preserved hay-paddock or the corn-field: she does not eat all bare before her, but luxuriates along, trampling down much more than she eats. This leaving of something for the rest of the flock or herd is not only a general law in the economy of gregarious grazers, but those who choose to examine into nature will find that it varies with the power which the rest of the flock have of coming up: not, of course, with the condition of the particular individuals, for gregarious animals often expel the diseased and the weakly, but with the average powers of the species. What has been now stated is the true theory of gregarious grazing; and the story of the herds of springboks, which is repeated in even the most recent compilations upon the subject, must have been introduced by some one who had never examined the animals, and was otherwise very ignorant of the most obvious and general principles of natural history.

So well are the springboks, in particular, fitted for thus changing from the rear to the front, even by bounding over each other, that it is from their constant practice of the upward leap, even when there does not appear to be much occasion for it, that the Dutch boors have given them their vulgar name. It is said that they appear to take these upward bounds for mere amusement; but an animal never uses for amusement any action which is not given to it for some important purpose in its economy. The frisk of the lamb becomes the power of leaping the fence in the sheep; the gambol of the kid, the faculty of bounding from ledge to ledge of the cliff in the goat; and, in like manner, as the springbok does not inhabit the cliffs or the thickets, we may conclude that it leaps in advance so as to get its share of the food.

The Blissbok, or Blaesbok, from its white mark on the face (*A. pygargu*), is another species of the plains, which, like the springbok, was once very numerous, but it is now rare, even in the northern parts of the colony. This species bears some resemblance to the springbok in its form, but it is larger and more stoutly made. The full-grown specimens are rather more than five feet and a half in length, and stand fully three and a half at the shoulders. The horns are lyrated, annulated to very near the tips, and about a foot and a quarter long in the male; in the female they are shorter, and not so stout, but they are of the same form.

The Blissbok.

The colours are so strikingly contrasted, that the animal is sometimes called by the epithet "painted." The face, from the muzzle to the eyes, is white, from the top of which there is a narrow stripe of the same, continued to between the bases of the horns. The rest of the head and the neck are a deep reddish-chestnut, and so are the bases of the hairs on the back; but the points of these are of a dull whitish straw-colour, which, with the chestnut below, produces a mixed and very peculiar tint. This colour is bordered on each side by a broad band of brownish purple, which is continued over the lower part of the haunches; behind that there is a patch of white passing up the posterior sides of the hips, and encircling the root of the tail. The tail is dark coloured, nearly naked for eight inches from the root, and there ending in a thick tuft of black hair, about four inches in length. The whole extends along the belly and breast, and the insides of the fore-legs; the outsides of the legs are blackish or purplish-brown, and there are no knee tufts. The head of the animal thus shows two strongly contrasted colours, and the body three, all well defined, and not blending with each other.

These are the colours of the adults; but the young are so different, that they have sometimes been described as another species; and as we are not well acquainted with the changes of colour with age in any of those antelopes, of which a specimen is seen only now and then, the mistake in this species renders it possible that there may have been similar mistakes in others; and that those described species, between which the only or the chief distinction are differences in size and in colour, are, in reality, the mature and the young of the very same species. Great caution, at least, is necessary in speaking of animals, the numbers of which are very great, but of which only a straggling specimen is found now and then, the more so, that some gregarious animals have a disposition to expel from the herd any individual that is peculiar in appearance. If there is but one black sheep in a flock, it is generally found at the outside, or even at a little distance; and if there are a few such they are usually found together. This may, to a certain extent, account for the origin of coloured varieties in gregarious animals.

In former times the blissboks were much more resident within the colony at the Cape than the springboks; and though they are now more restricted to the interior than they were formerly, they still come more to the south than that species. They are more showy in their colours, but not nearly so lively in their motions; and they are not now found in such large flocks as the springboks are when they do make their appearance. They do not appear to have the same sensibility to the weather as the springboks; and indeed it is a general law of nature that the more migrant any animal is, it is the more sensitive to changes of the weather. This might be inferred from the fact of migration, without any observation to confirm it; because it is sensitiveness to the weather which is the immediate cause of migration; but observation confirms this theory. The springboks, even in a state of domestication and confinement, show great restlessness, and frisk about when the south wind blows; and in the country of the Cape, the south wind is the dry wind, so dry as to wither the vegetation in a very short time; and therefore it is the signal for the migrant antelopes generally, and especially for that, apparently the most migrant of all the species, to escape to more northerly regions, where there is still verdure on the face of the country. How far this dry wind of the southern monsoon may extend into the interior of the country, has not been stated, and indeed the country has not been sufficiently explored for that purpose; but there is no doubt that, to the full extent of its range, it carries the drought along with it, and renders the migrations of the grazing animals necessary. On the other hand, when the monsoon turns, which it does as soon as the southern parts become intensely dry, the rains begin; and as the south wind is first contended with in the interior, and so gradually more and more southerly, and as the rain always falls at the place of contention between the two winds, the progress of the rain, and of the vegetation and consequent migration of the animals, is towards the south, and terminates in the territory of the Cape. The most probable theory in a case like this, where, though there are analogies there are no facts, is, that the plains which are ranged by the migrant antelopes extend to the mountains south of Abyssinia, usually called the Mountains of the Moon; and that the wind from them to the plain at their base, when that begins to get dry and heated, is the turning of the season of the monsoon. See ATMOSPHERE and MONSOON.

The GEMSBOK (*A. oryx*) is another inhabitant of the plains of Southern Africa, but differing considerably both in its appearance and its habits from the two species last mentioned. These antelopes live in pairs, or at most in very small herds, and, as is the case with most grazing animals which have that habit, they do not migrate much or far, but rather shift from place to place within the same locality. They are not, indeed, so well fitted for long journeys as the springboks and other more elegantly formed antelopes; but in proportion as they are less fitted for shifting their quarters they are more capable of endurance, being much more robust and stoutly made.

Their linear dimensions are inferior to those of some of the lighter species, being only about five feet in length, and a little more than three in height at the shoulder; but their legs are stout, their bodies firm and compact, their horns very formidable, and they are endowed with no inconsiderable share of courage and determination. The horns are in the plane of the forehead, nearly straight, inclining very little from each other at the tips, stout and more than two feet in length. In colour they are black, firm in substance, very slightly annulated, rather blunt at the tips in the male, but sharp in the female. The animal charges with them like spears; and as it stands firm upon its well-knit limbs, none of the smaller carnivora can venture to spring upon it with impunity. It keeps clear of those places in which the lion crouches ready to spring, and when he is ranging or prowling it is said to dart in upon him, and either put him to flight or transfix him with its powerful horns. That is probable, inasmuch as the lion, assailed on the flank, or any way behind, is by no means so formidable as when he can spring, or even when he can strike with the paw.

Though not so grey as the blissbok, this species is rather handsomely marked. The head is white, with two bands of black extending from the bases of the horns to the eyes, which they encircle; they are then deflected obliquely backwards and meet under the under jaw, continuing in one black stripe down the middle of the throat to the fore-legs, then it again divides into two, first encircling each fore-leg with a ring of considerable breadth, then passing backward along the flanks and encircling the thighs in a similar manner. The tail also, which is bushy, the greater part of its length is black, and there is a black spot upon the cannons. The body above the black is reddish grey, and below white, as are also the legs with the exceptions that have been mentioned. The hair on the upper part of the shoulders is rough, and from being turned forward it has a good deal of a shaggy appearance. The hunting of this antelope is a matter of considerable danger, because when wounded it is apt to turn upon its enemies with great boldness and effect. It is said to get much fatter towards the close of the season of plenty than the more migrating antelopes, which agrees with the analogy of other animals in other places; but it is still sufficiently fleet and capable of flitting from place to place, to render the possession of a store hump unnecessary.

The CANNA (*A. orcas*). This is the largest and heaviest of all the species in Southern Africa; and as it is not more migratory than the gemsbok, and much more gregarious, it is furnished with certain provisions against the season of scarcity which that species is without. Toward the end of the season of plenty it gets very fat, and it has also a sort of hump upon the shoulders, which is most prominent when the animal is in the best condition.

In countries where the contrast of the season of rain and plenty, and that of drought and want is very great, the hump appears to be an important organ in the economy of these grazing animals, which from structure or habit (the two generally go together) do not migrate. We have striking instances of it in the camels, and in many of the ox tribe, and some of the sheep have a substitute in the tail. All these protuberances get large and firm when the animals are in good condition; with scanty feeding they become soft and flabby, and before the animal perishes of hunger they disappear. As that provision, in a great measure, disappears in those climates where the pastures are perennial, and appears again, either in the form of a hump or dewlap in the colder latitudes, no doubt of its purpose is left; and there is a farther corroboration in those animals which live upon mosses and lichens, and can scrape their food from under the snow, being without any such provision. See HYBERNATION.

The canna is not less than eight feet in length; and it stands fully five feet high at the shoulder, so that, in as far as is known, it is considerably the largest of the whole genus. Its legs are thick and strong, clumsy as compared with those of many other antelopes; and its hoofs are broader and not so much pointed. The haunches are large and thick; the body heavy, the neck much bent down at its articulation; a slight hump behind the shoulders, and a tolerably large goitre on the throat; the muzzle is more square and ox-like than in most of the antelopes; the horns of the male are very thick and strong, but tapering to the tips, and instead of being annulated, they are wreathed with a spiral projection; and in the female the horns are more slender, and the spiral is not so conspicuous. In the male they are about two feet in length, and in the female a few inches less. From between the horns, all along the neck and back to the rump, there is a short erect mane, from which the hair, on the upper part to about the middle of the loins, is shaggy, completely hiding the dewlap and goitre of the throat; and the upper part of it concealing the hump on the shoulders. It is necessary to mention that the hump on this animal differs from that on the camels and humped oxen. The processes of the vertebræ penetrate its substance nearly to the skin, and are of course accompanied by muscles, so that the deposit which is made in it is simply fat; and when it is exhausted it does not sink down but shrinks laterally. The head and neck are quite grey, the upper part of the body reddish-fawn, and the under part white; but the colours, especially that of the upper part, are subject to considerable variations.

Both the disposition and the flesh of this animal correspond with its habits. It is mild, and confiding rather than timid, so that it can be approached much more readily and closely than any of the rest. A few hunters can indeed drive the herd as if they were domestic animals; and one regrets that, in the cultivated parts of the country, they have not been tamed rather than extirpated. But, as already noticed, the instinct has been to kill every living thing which was native in Southern Africa, and a mean course is now too late. These animals are now to be found only in the more remote and wilder parts, and they are not very plentiful even there. Report says that nature, as is usual in all cases of ignorant and wanton destruction, is taking her revenge, and that the karroos, which once afforded seasonal pasture to so many antelopes, are fast passing into perennial and irreclaimable deserts. This is exactly what might have been expected; the grazing animals are just as necessary to the plants on which they feed as the plants are to the animals, so that the destruction of the one, where cultivation comes not instead, always involves the destruction of the other. But these animals are large; their flesh is far more tender and juicy, and of finer flavour than that of any of the other antelopes; and when in season they are very plump and fat. Thus, as has often been the case in other matters, the superiority of their usefulness to man has been the cause of their destruction.

The Caama (*A. caama*) has, in some of its habits, and in the flavour of its flesh, more resemblance to the ox tribe than even the canna. The species of antelope to which the caama has the closest likeness is the beker-el-wosh (wild cow of northern Africa), which at a distance has no inconsiderable resemblance to a cow with a thin body and long legs. The dimensions are large, the full grown male being at least seven feet in length, and standing five at the shoulder; but the dimensions of the female are considerably less. The body is strong and compact, especially about the haunches; the neck has none of the ox character, but is round, and has a contrary flexure. The muzzle is much produced, slender and rather pointed; the ears are large; and the horns are not far out of the plane of the forehead, though inclining a little forwards during the basal half of their length. The surface of that half, especially on the anterior side, is very rough and knobby, while the remaining half, which is nearly parallel to the line of the face, is smooth. The tail is of moderate length, slender, and with a brush at the end. The general colour of the upper part in this species is yellowish-rusty, darkest on the shoulders and ridge of the back. The general colour below is white; and there is a large triangular white spot upon each hip. A spot before the base of each horn, another on the terminal part of the under jaw, and the brush of the tail are black.

These animals are found on the dry plains of Southern Africa, in little parties of from a dozen to twenty, but keeping close to each other, and apparently much attached. The party is generally under the leadership of one old buck, who exercises pretty severe and constant discipline; but is just as ready to defend his charge when danger appears. The Dutch boors call him the "hartebeest," that is, the buck ox or the stag ox; and though, in his more essential characters, he is a true antelope, he certainly has some of the appearances of the ox and some of the habits of the stag. One of the most remarkable of the latter is, that of "standing at gaze," that is, taking a long, steady, and determined look, full faced, at any thing suspicious, in order to deliberate, as it should seem, whether to fight or to fly be the better alternative. If the former is the conclusion, attack is the mode of warfare; and though the mode of attack is not peculiar to this species of antelope, but common to most of the larger ones which inhabit open places, it is still both curious, and, to an unwary enemy, most formidable. He marches toward the enemy, snuffing the air and menacing a little with his horns till he succeeds in arresting his enemy's fixed attention. Then he drops on the knees of the fore-legs, and brings the muzzle backwards till the horns are charging in front like spears or bayonets. In this way he shuffles forward till he judges his distance to be the proper one for the spring; and then he bounds forward as if discharged from a bow, delivering the whole weight and impetus of his body upon the horns, in such a manner as would transfix a lion, were even that powerful beast to abide the collision. By a steady eye he, and all others that have this habit, are, however, easily avoided; as one step taken hastily aside after they are in the air, is sure to cause them to miss their aim. Though the caama has been much thinned by that indiscriminate slaughter which has been practised against all wild creatures in southern Africa, it is still the most numerous and also the most resident of all the larger antelopes; and considering the very hard pasture on which it can subsist, compared with that upon which beef and mutton can be rendered any thing like tolerable, and considering also the hints which, so to speak, the animal itself has absolutely given to that effect, it is really astonishing that it has not been added to the list of domestic animals. The young, of which the female produces a single one in the year, in September or in April, according to circumstances, are very easily domesticated; and as the flesh of the animals is abundantly sweet, and improvable with improved pasture, they might be made valuable.

The Ourebi, the bleekbok of the Dutch (*A. scoparia*, from its large knee brushes), is a much smaller species than the former, but inhabits nearly the same places, but is perhaps not quite so gregarious. In some of its characters it has a resemblance to the nyl-ghau of India, but it is considerably smaller. In the Cape Colony it is much more numerous toward the east and north-east, and beyond the British frontier; and it is sometimes supposed to extend along the whole eastern side of Africa, as far as at least the remoter sources of the Nile, if not farther. Its flesh is held in considerable estimation; but from the peculiar character of its pastures it is very dry to Europeans. It is said, however, when cured, to support the strength for a long time.

These animals are numerous, and they feed near each other, so much so, that all those which are found on the same pasture appear to be acquainted with each other. But they are merely acquaintance upon good terms, but doing nothing in concert. If one is taken the rest show no alarm; and if an alarm is given to the herd, each one seeks safety in its own independent course. Their associating in numbers without any principle of society, leader or rallying point, puts one much more in mind of the flocking of birds than of the usual associating of gregarious mammalia.

The dimensions of the Ourebi are, from the muzzle to the insertion of the horns, about seven and a half inches, the neck and body thence to the tail about three feet, and the tail about three inches and a half. The height at the shoulder is about one foot ten inches, and that at the croup fully two inches more. The horns are five or six inches long, rather slender, but firm, nearly straight, and very sharp at the points. They have a few wrinkles at the base, and then five or six well-marked rings; but these do not occupy altogether above an inch and a half at the base, so that more than four inches are black, smooth, very firm, and keen pointed. The position of the horns inclines a very little forward from the plane of the forehead.

The colours, especially on the upper part, vary in tint in different individuals; but the general colour is pale yellowish-brown. The under part, the posterior surface of the hips surrounding the base of the tail, the chin, the lips, and a bar over each eye are white; and the hair on the tail, which is rather thick and bushy, is jet black, which contrasts strikingly with the white around it. The fact of being higher at the croup than the shoulder shows that this animal is a leaper; and another consequence of its erratic habits is said to be that at no season is there any accumulation of fat upon any part of its body.

The plains of Southern Africa, in which the greater part of the antelopes of that country which have been noticed, find their food and take up their abodes periodically or habitually in flocks, in packs or in a more solitary state, terminate in three different ways, and each of these is marked on the boundary by antelopes of a character somewhat peculiar, or at least different from those found on the others. These are: first, evergreen forests by the banks of the large rivers, and the antelopes which inhabit there are, generally speaking, of tall stature, with produced, and often elegantly twisted horns, and they feed in part upon the green leaves and branches of trees. Secondly, "the bush," that is underwood or shrubs, which for part of the year are without green leaves; but among which there is even then dry vegetable food of some description to be picked up. The antelopes which inhabit these places are better formed for leaping and of smaller size; and thirdly, rocks, which are often very abrupt and wild, and the antelopes which inhabit them have a power of bounding and also of balancing themselves upon narrow ledges and sharp pinnacles which is truly astonishing, and leaves them, unless taken by surprise, pretty safe from wild beasts, as none of these can follow them in their boundings from rock to rock; and it is doubtful whether a cat, with all the flexibility of her spine, could remain for one second upon a point on which one of these wonderful creatures can not only balance itself for several minutes, but from which it can take a new spring, upwards, downwards, or laterally, as may be required.

But besides the species which have been enumerated, and some additional species which have been omitted because the accounts of them are not satisfactorily made out, there are certain other antelopes of the South African plains which, in some of their external appearances, and even some of their actions, appear to connect the antelopes with the horse which, as every body knows, is a solid-hoofed animal not ruminant. At first this seems something of an anomaly in nature; but when we consider that antelopes are the predominant grazing animals of that country, and that where they cease to come their place is taken up by many races, and among the rest by some of the horse genus, as the zebra, the dow, and quagga, we begin to discover that an approximation to these, as well as to the ox and the goat tribes, is necessary to adapt the whole of the races to each other and to their localities, so that no pasture may be unoccupied. Of those antelopes which have a slight trace of the horse in their form, the best known certainly, and probably the most abundant, as well as the most interesting, is

The Gnu (*A. Gnu*). This species, which some systematists make the type of a separate genus, and others include in the great genus *antilope*, is by no means so large in size as some of the species which have been mentioned; but in restless activity and in disposition to do mischief, it is the most conspicuous of the whole. They seem to be continually using their formidable horns, either in butting against each other, which they do playfully, or in attempting to root up trees and bushes, and gore or fight any other animals that come in their way. The height both at the shoulder and the croup is an inch or two under four feet, and the length from the muzzle to the tail is about six feet and a half. The form of the neck, body, tail and legs, with the exception of the feet, is exactly that of a small, compact, fleet, and strong horse; the feet are those of an antelope, the head and muzzle have a good deal of resemblance to those of the ox; and the horns, though somewhat intermediate between those of the buffalo and some other of the antelopes, have so many peculiarities that they cannot be described by comparison. The head is square, the muzzle broad, the neck rather short, but beautifully arched like that of a fine horse, compressed throughout its length, deep at its union with the body, but much less so at the head; the shoulders are deep, and the chest ample and muscular; the body is short, but straight, cylindrical, and very firm; the croup is remarkably broad, and the breadth is farther increased by a hump of fat on each hip; the tail is much longer in proportion than that of most antelopes, and it is covered with long hair throughout the greater part of its length, and borne flowing, like that of a high mettled horse; the legs are long and peculiarly handsome, but at the same time expressive of great strength as well as fleetness; even the ears have a considerable resemblance to those of a horse, which is increased from the peculiar bend of the horns not interfering with them; the neck and upper part of the back for a short distance are furnished with an erect mane of very hard hairs from four to five inches in length; there is also some long hair on the under part of the neck, and a large bunch of the same along the sternum, upon which there is a small dewlap.

The horns originate very near each other in the forehead, a little before the line of the ears. They adhere to that for a considerable part of their length, forming a strong bony frontlet, the two divisions of which diverge till they nearly reach the orbits of the eyes. Just at the orbits they become smooth and form their curvature downward till within a short distance of the nose, and then upwards again till the points are nearly on a level with the roots of the ears. This curved portion, which forms nearly a semicircle, has a bend outwards, so that when the animal is seen directly in front, the eyes appear in the bend of the horns, very bright and glaring. The head, which is so peculiar in form, is rendered still more warlike by a great beard on the chin, mustachios on the upper lip, and a sort of whiskers on the cheeks.

The females are pretty similar to the males, only the horns are perhaps not quite so large, and the general disposition not quite so mischievous. The females have two mammæ, and it is understood that they have not more than one young at a birth.

The general colour of the male is deep brown; and that of the female paler, with an ashen shade; the hair on the bodies of both being short and smooth, and thus allowing their symmetrical forms, and also the ornamental hair of their manes, tufts, and tails to appear to the greatest advantage. In the young animals the bristles round the eyes and mouth are almost entirely white; and so are the lateral and shorter rows of stiff hair in the mane, but the centre and longer ones are black, which gives the mane the appearance of being white, with a black border along the distal edge. In young specimens too the greater part of the produced hairs of the tail are white; but as they get older the white hairs diminish in number; and the old males which lead the herds in the karroos or dry plains, are said to be almost, if not altogether, without white. The young, on the other hand, are nearly white all over, and gradually deepen in colour as they approach maturity.

The gnu is not found at present nearer to Cape Town than the grand karroo in the interior of the colony; and it is so wild, that probably its numbers have been less diminished by the left-handed zeal of the boors than those of the other antelopes. The name given to it by the Dutch is "wilde beest," which means wild ox. These animals appear in considerable flocks; and from their manes and tails, the manner of carrying the head, which partially conceals the horns, and also from many of their paces, they might be mistaken, even at a moderate distance, for troops of wild horses; when advanced upon, they begin to fling with their heels, to butt laterally with their horns, and to play a number of antics as if they were practising a species of energetic and not inelegant military exercise. If advanced upon by numbers, they do not show battle, but retreat in regular order and with great rapidity; halting and forming again, after they have escaped to a certain distance. If, however, they are wounded, they become dangerous, because they turn upon their pursuers, and fight with great courage and desperation to the very last effort. Single males will sometimes, it is said, also advance upon a single enemy, while the rest of the herd remain at gaze watching the issue. In these cases, the general mode of fighting is that which has been described as practised by other species; but the gnu comes more briskly and rapidly to the ground, on which he kneels; his plunge on the enemy is also more headlong and desperate; and he falls more on his feet, and uses his horns with more execution. Gnus are indeed animals with which it is by no means safe to tamper; their strength and speed are both very great for their dimensions, and they appear to be irritated to pugnacity by the merest trifles. In these respects they bear a considerable resemblance to the nyl-ghau; and though as, like that, they are hardy animals, they would no doubt breed in ornamental grounds in England, yet both are somewhat dangerous either for the other ruminant inhabitants or for human visiters. In its native wilds, the gnu is a most interesting animal, lively, brave, handsome, and capable of bearing great extremes of temperature and humidity; but it is not an animal which can be profitably tamed, or even shown to advantage in confinement.

Two or three other species have been mentioned as classible with propriety along with the gnu, into a separate genus; these are represented as being all rather larger in size and not quite so singular in their combination of appearances as the gnu; but all of them are little known, and some rest upon single and not very well authenticated specimens. That there are considerable diversities of size, colour, and even shape and development of the horns in the same species is tolerably well ascertained; and there is another point which, though it has not been often adverted to, is worthy of being taken into account before a genus, a species, or even a variety is founded upon a single individual, or even upon one or two seen at different times, or even several individuals, seen occasionally and distant from each other. Though the fact has not been put to the test, there is little doubt that most of the animals, and probably all of them, are capable of breeding with each other; some resemble each other so nearly that the cross breeds may be fertile; and it is not unusual, or rather it is the general law of cross breeds among other races, readily to breed back to the pure blood. Now the different parts of antelopes often correspond in one part between two species, while they are very different in another part; as, for example, the horns are alike, the bodies are alike, or the limbs are alike; but each of the other two are different; and it is natural to suppose that a hybrid between these might agree with both in the common part, and with one of its parents in one of the others, and with the other parent in the other one. This, of course, would, to those who do not study the manners of the animals, or pay much attention to their anatomy, but simply kill them, and fetch away the skin and horns for the purposes of exhibition, constitute a new antelope. This doctrine cannot be pleaded in positive opposition to any thing which has been alleged concerning the species of antelopes, because it has not been investigated; but still it deserves to be mentioned as a ground of caution, and one the extent of which can be determined only after the facts are sufficiently known.

The Kokoon (*A. taurina*—bull antelope) is described as inhabiting places farther into the interior than the gnu; and, like that, assembling in large herds, but not associating with gnus, or mixing with them on the same pastures. It is much larger than the gnu, but stands very differently on its legs, being considerably lower at the croup, with the hinder parts rather feeble, but the anterior ones, the head, neck, and shoulders, are very powerful. It is, however, said to be a dull and timid animal in comparison with the gnu; and the elevation of its fore-legs, as compared with its hind ones, would lead one to suppose that during part of the year it must feed on the pendent branches of trees and on shrubs. The horns are rather more slender than in the gnu, and instead of passing down between the eyes, they pass on the outside, and then are recurved upwards, but very little forwards. The colour of this animal is described as being of a dark ashen-grey, that is, as having a slight resemblance to the female gnu. The *brindled gnu*, and one or two other species, have been described as differing from this one in the shape of the horns and the colour of the body, but too little is known of them for the purposes of popular natural history, or even for establishing the fact of their being distinct species.

The Pallah (*A. melampus*). This species, which is the *rodebok*, or redbuck, of the Dutch colonists, though it comes not much within their territory, is an animal of light and graceful figure, and is swift in its motions, resembling in many respects the common antelope of Asia, only it is a little larger. The head is small, the muzzle rounded, the eyes prominent, the ears rather large, the neck long and beautifully formed, the chest and belly rather slender, but the hips stout and finely rounded, indicating a leaping animal. The males only have horns, which for the last third are black and smooth, with sharp tips; the remaining two-thirds are distinctly annulated; and the horns are lyrated, and rather slender throughout. Lightness and grace appear indeed to be the leading characters of these very lively animals. The general colour on the upper part is a rich reddish-brown, with a definite jet black line down the ridge of the back, separating into two near the tail, and proceeding down so as to form a sort of oval round the insertion of that member. The under part, including of course the insides of the legs and thighs, is white, and so also are the lips, a spot or line over each eye, and the interior of the ears.

The length is fully four feet and a half, the height at the shoulder three feet, and that of the croup perhaps an inch or two more. In the full-grown animals the horns are about twenty inches long, and the tips are not more than three or four inches apart, although at the middle of their length they are more than a foot apart.

Though not seen within the Cape colony, they are described as being very numerous on the plains further to the north, especially those on the north or right hand bank of the Orange river, near the tropic of Capricorn. They are described not as gregarious, but as living in families of about five or six each; and they are said to display nearly equal leaping powers with the springboks, but they live in a rather more westerly situation, and do not appear to be so migratory as that species. They are eagerly hunted by the natives, who prize their flesh highly; but its quality is a point upon which Europeans have had but few opportunities of giving an opinion: they are, however, one of the species of whose characters and habits it would be desirable to know a good deal more.

The Steenbok (*A. tragulus*). As its Dutch name *Steenbok*, that is, stonebuck, implies, this species is found chiefly in stony places, not among the mountain crags, or indeed living rocks of any kind, but rather upon those upper plains or flats near the rocky hills or mountains, which are interspersed with large fragments and bowlder-stones. Such places, though the pasturage which they afford is generally sweet, and the shelter of the stones in so far protects it from the action both of the drought and of violent winds, so that it lasts for a longer period of the year than the pasturage of the more level and exposed plains, is yet at all times both scanty and scattered, and requires great powers of locomotion in any animal which has to find the greater part of its food there. The steenbok is in consequence an antelope of peculiarly light and buoyant form, remarkable for the length, slenderness, symmetry, and graceful motion of its limbs.

The steenbok is but a small animal; the length of the head to the horns being four inches, and two inches more to the ears, the length thence to the tail is rather less than three feet, and the tail is a mere lump or tubercle not easily perceptible. The height at the shoulder is about one foot seven, and that of the croup two inches more, indicating a leaping animal; and it clears the larger stones on its pastures with wonderful agility. The male only has horns, small, round, slightly furrowed at the bases, very smooth in the rest of their length, and sharp pointed. In many positions of the ears, the horns are concealed by these organs, which are double the length and broad in proportion. It is worthy of remark that, generally speaking, in the same genus of animals the species which find their food in the hardest and most arid pastures have the largest ears, and, it is presumed, the most acute sense of hearing.

The Steenbok.

The head is oval, and tapering to the muzzle which is round, small, and black. The eyes are high in the head, with black sinuses under them. The forehead and nose are pale chocolate-red; the sides of the face and chin, fawn-colour; the neck from the nape and all the rest of the upper part from the croup chocolate-red, passing into deeper red on the sides of the neck, the flanks and the thighs. The breast and under part generally, including the inner sides of the thighs, are white, with the exception of the groin, which is black, and nearly or all together destitute of hair, the lower part of the legs is dun or dark buff. There are no knee brushes, but the knees of the fore legs have small callosities. The pasterns are very short, the hoofs are also short but rather high, black, and firm in their texture. There are no false hoofs on the legs. There is one peculiarity in the colouring which deserves to be mentioned: a black line proceeds from the root of each horn in the male, and the two meet between the ears, forming a very blunt angle. This marking is more conspicuous in the harmless females than in the males; for in them the stripes begin and terminate in the same way, and there are no horns to conceal them.

The steenbok is a native of those places of the Cape which are not far from Cape Town; and it is generally scattered over all the stony flats which are found immediately below the sides and also in the gorges of the mountain ridges. Those haunts expose the animals, especially the young, to great depredations from birds of prey, eagles in a particular manner. They are also met with in more localities than most of the other species; and hence they are very generally hunted as game. They are timid and fleet, and when pursued can take such bounds as to clear obstacles of from twelve to fifteen feet in breadth; but they are mild and gentle, and not only do not turn upon their pursuers, but when pushed to extremities, they conceal their heads in holes or in bushes, and suffer themselves to be taken. Their flesh is held in considerable estimation.

The Grysbok (*A. melanotis*). This species has a very considerable resemblance to the steenbok both in its structure and its habits; but it is more stoutly made, and the legs in particular are both shorter and stouter. It is altogether four or five inches shorter, and stands about two inches and a half lower both at the shoulders and at the croup. The horns and ears are also much shorter: the former being only about two and a half inches, and the latter five. The horns stand immediately over the orbits; they are straight and smooth, and shining, except a few small annuli at the bases. The tail is merely rudimental, and does not appear beyond the hair. The upper part is of a moderately intense crimson colour, and consists of rather long hair, as indeed does the whole covering of the animal. But the red hairs are uniformly mixed with a thin sprinkling of longer white ones, which give the upper part a hoary aspect, and it is for this reason that it is called the grysbok or grisly-buck. The head and the lower parts of the legs are fawn-colour, and the rest of the under parts light sandy-brown. The muzzle, the openings of the sinuses, a small circle round each eye, and the backs of the ears are black; but the latter are thinly powdered with white hairs, being otherwise almost naked.

Its pastures are not exactly the same as those of the steenbok; for while that resorts to places near the mountain rocks, this rather frequents those which border upon the mountain bushes and mountain forests,—the scrubby places which are scattered with low bushes, in nearly the same manner as the haunts of the steenbok are with stones. Like that species it is not gregarious, but found in pairs, which, though similarity of haunt brings them into each other's locality, appear to take no interest in each other. It is not nearly so fleet as the steenbok, and therefore in open places it is much more easily caught; but its bushy pastures afford it cover in which it conceals itself very adroitly, and is not easily driven out. It is, perhaps, more common in its proper localities in most parts of the Cape than the steenbok; and its numbers are much less liable to be thinned by the eagles, as the young are concealed under the bushes, which shield them equally from the vision and the pounce of their winged foes. The bushes in such places are generally hard and stiff, and not unfrequently beset with strong prickles; so that though an eagle were to espy a young grysbok under one of those bushes, and stoop at it, she would gain nothing but a thorough scratching, and the animal would escape to a place of safety before she could possibly disentangle herself. The flesh of the grysbok, like that of the former species is, though at all times destitute of fat, held in considerable estimation by the colonists.

The Koodoo (*A. strepsiceros*). This splendid animal gets the name strepsiceros from the numerous and graceful turns or flexures of its magnificent horns. These horns are among the most showy borne by any animal. They rise together from the crown, bend gradually outwards, then inwards and outwards again, with several flexures which have in each horn the character of a very peculiar spiral; and their remarkable curvature is rendered more striking by a projecting ridge which winds very gently round them, so as always to keep on the convex side of the curve. They are very thick and strong at the bases, from which for a considerable distance they are wrinkled but not annulated. The basal part, as far as the wrinkles, is brownish horn-colour, the middle part of the horn black, and the tip white; each horn is, measured along the windings, not less than four feet in length; and as the animal which carries them is large, they have a very showy appearance. The length of the full-grown koodoo is not less than eight feet; it stands fully four feet at the shoulder; and when the head is carried erect, the points of the horns are at least four feet more. There is a good deal of sheeplike expression in the animal; and from the account given, it will be seen that the horns are something intermediate between those of the sheep and the antelopes. The ears, face, and muzzle are broad; the neck and body are heavily and rather loosely made; and the legs are thick, without many indications of agility. The general colour on the upper part is light greyish-brown, with a white line down the back, and a number of small bars descending thence over the sides and flanks; the lower parts are whitish-brown. Along the neck and on part of the back there is a sort of straggling mane; and there is also a beard on the chin, which is continued along the neck, and as far as the posterior edge of the sternum.

Though from its size, the form of its horns, and the contrast of its colours, the koodoo is an animal well calculated to arrest the attention; yet it has none of the wonderfully buoyant characters, which are so remarkable in those smaller creatures, which scour along the deserts like the wind. The koodoo is an animal of richer pastures, and less laborious pursuits. It lives in the thick forests near the perennial rivers, where, when the grass happens to fail, abundant food may still be had in the leaves and young shoots of trees. It does not, therefore, require to migrate; neither has it any masses of stone to overleap, any rocks to climb, or any deserts to traverse. Its greatest annoyance is water, when its pastures are partially inundated or divided into islands during the rains. On these occasions koodoos readily betake themselves to the water, and swim with considerable ease, their heavy horns resting partially on the back, assisting them in keeping the muzzle elevated above the water. In their ordinary ramblings through the forests, which are usually not at a very quick pace, the horns seem a sort of lumber to them, and they then, in some measure, carry them on their backs. It is possible that this may assist them in respiration, as the direction which that gives to the muzzle brings the nostrils into purer air than can be expected nearer the surface, where so many substances, both animal and vegetable, are in a state of putrefaction. Indeed, unless they serve some purpose of this kind it is not easy to see why many of the sylvan antelopes are furnished with even larger horns than those of the open plains, horns which can be of little service either as a means of defence, or as auxiliaries in finding their food in dense forests. The uses of horns in those animals which have them is, however, a point to which much philosophical attention has not been paid, though it is certainly one well worthy of investigation. The koodoo is not a swift animal, because swift marches would be but of little value in a forest; but it can endure much fatigue, and it leaps with great power and energy, so as to clear readily a bush or other obstacle ten or twelve feet high. The female has but one young at a birth; and the young are gentle creatures, domesticated without any trouble, and never attempt to regain the wilds, so that they might be rendered highly ornamental in Europe as park animals. The males too, though they stand at bay with sufficient boldness and resolution when attacked, are not understood to be in any degree vicious or disposed to act on the offensive. From the nature of their haunts they are animals which are not very much seen by Europeans. They are said to live in small packs.

The Boshbok (*A. sylvatica*) is another inhabitant of the forests, smaller in size, more active in habit, and more generally distributed than the koodoo. This animal is found in most of the wooded districts of the Cape, to which it keeps close during the day, but comes out early in the mornings and during moonlight nights, and not only grazes in the adjoining pastures, but makes free with the corn-fields and even the gardens of the settlers. Its voice is said to resemble the barking of a dog; and on that account it is said often to mislead travellers in the forests. Hearing its bark, they proceed upon it, never doubting that they shall come upon a house-dog in a cottage; but when they approach it, so that it hears the rustling of the branches, it immediately becomes close and silent; and of course neither dog nor human dwelling is found. The deception is not, however, at an end; for instantly another begins to bark at some distance in advance, and continues till approached in the same manner. After that a third, and so on, so that the forest may be ranged from morning till night with the apparent bark of the dog still near, but neither dog nor cottage ever seen. The habit of the animals renders this species of deception very perplexing. They are not gregarious, or reposing in a herd at one quarter of the forest, and again in another quarter. They live solitary, or at most in pairs; and when the female has young ones following her, of which there are often two, the male lives apart, so that they are dispersed over the whole forest. Their flesh is much esteemed, and they are hunted with considerable avidity; but still their numbers have been much less thinned than those of many other species; and they appear better calculated for being game animals in coppice preserves than almost any other of the antelopes.

This species measures about four feet from the muzzle to the tail, and stands about two feet and a half high at the shoulder. The horns are about a foot long, thick at the bases and tapering to the points, which, however, are rather blunt. They are twisted, or rather wreathed spirally by two prominent ridges for the first two-thirds of their length, the third next the tips being smooth. The ears are large and rounded; the fur thick but not shaggy; and, the horns excepted, many of the characters of the animal resemble those of the fallow deer. The male has the ground colours dark sooty-brown on the upper part, and white on the under; the cheeks bright reddish-brown, and the legs yellowish-brown, passing into grey in very old specimens. The lips and chin are white, a white spot surrounds each eye, there is a white band round each extremity of the neck, white spots in the cheeks, and some dappling with white on the haunches, but the white markings are subject to variety in different individuals, and also in different ages. The markings of the females are nearly the same as those in the males, only those on the upper part are less conspicuous, because the ground-colour of the female is reddish-fawn, of rather a pale tint. The difference of colour in the males and females appears before they reach full maturity; but the brown, and also the white in the males, become more conspicuous with age.

The Duikerbok (*A. mergens*) is another inhabitant of the bushes or copses, and also of the taller forests in which there is much underwood. It is equally numerous with the last mentioned species, and though not quite so familiar in its manners, it occasionally pays nocturnal visits to the corn-fields and gardens.

In its native woods it is even more difficult to be seen, because it plunges under the bushes, instead of leaping over them; and it is on this account that it is called the duikerbok, which means, the diving or plunging buck. They live dispersedly, or in pairs; and that farther diminishes the opportunities of observing it in its native haunts. In appearance, and also in manners, it bears a considerable resemblance to the bush antelope of western Africa, only it is more elegantly made, and more lively in its motions. The length of the body is about four feet, the height at the shoulder about two. The horns, with which the males only are provided, are rather small, straight, upright, very sharp at the tips, of a black colour, and altogether smooth, except two or three annuli at the base. The ears are rather long; and between the roots of the horns there is a coronal tuft of hair, which spreads round in all directions, and partly conceals those appendages, and also the ears. This tuft is common to both males and females; and it may serve (as the crests of some birds do) to render the outline of the animal's head less perceptible to enemies while it is raised over the bushes for the purpose of reconnoitring. The general covering of the body is long, but smooth and close. The prevailing colour is light-brown, with a trace of yellowish on the back, and one of greyish-ash on the under part. The centre of the face is dark-brown, the lower portions of the legs and the hair on the tail are black; there is not much difference in the appearance of the male and female, except the absence of horns in the latter.

The Kleenebok (*A. perpusilla*) is a very small and slender-limbed species, which has sometimes been confounded with the guevi of tropical Africa, though they are perfectly distinct, and no one of them has been hitherto found in the other's locality. The Dutch name means the little buck; and the epithet *blauw* (blue) is sometimes added as expressive of its colour. These animals are not gregarious or migrant, but live in pairs among the short bushes. They are exceedingly lively and playful; but at the same time so timid and prone to hide themselves in the bushes that they are seldom seen, even in those parts of the colony where they are known to be very abundant. They are very gentle in their manners, easily tamed, and docile, and soon taught to distinguish and go to those that are kind to them. The neck is very slender, the head pear-shaped, tapering much to the muzzle, which is slender; the ears placed far backwards, rounded at the tips, and nearly naked within. The horns are very small, being only an inch and a half in length in the male, and three quarters of an inch in the female. They are black, nearly erect, but with a slight inclination backwards, marked with seven or eight very minute annuli at the bases, but smooth and very sharp at the tips. The tail is about two inches and a half long, but very conspicuous from the rapid inward curvature of the outline of the hips. The general colour of the upper part is slate-grey, and that of the under ash-grey, but much paler and inclining to white in the young specimens. The forehead and nose are brown; but on each side a narrow line of a brownish-red colour proceeds from the roots of the horns towards the nose, and is met by an oblique one of the same colour under the eye. The legs are of a reddish-brown colour, very delicately made, and the hoofs are black, small, narrow, and pointed. It is altogether a very beautiful and very interesting little creature.

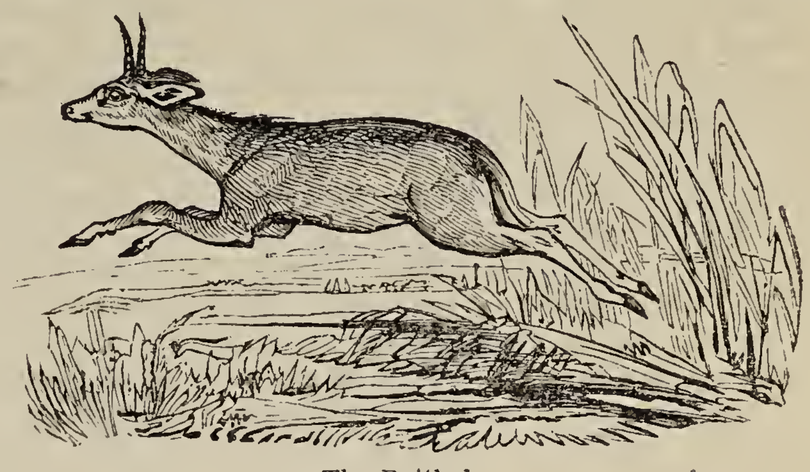
The Rheebok (*A. capreolus*) is of considerably larger size than the species last mentioned, and its haunts are different. It is a hill animal, frequenting the lower slopes of the mountains, especially when these are spotted with trees, and containing underwood between. It appears to be partial to water, as it is found in the vicinity of those places where pools stagnate after the rains; and as these dry up in one locality it shifts to another, never inhabiting at any great distance from the water. These animals are not gregarious, but they associate in packs or families, consisting of about half a dozen on the average; and made up of one male and two or three females with their young. The males fight battles of gallantry, as is the case with most polygamous animals, and the old males, as is the case among deer, drive off the young ones from the family as soon as they are full grown. In other respects they are gentle animals, and the young are easily tamed; they also come very frequently to maturity.

The form of the rheebok is graceful; both body and neck are small, and stretched for rapid running rather than for leaping, and its legs are slender, but finely formed. When stretching itself to its full speed its body is near the ground; and yet it glides along as if it were scarcely touching, and without any apparent leaping or exertion. As its flesh is very dry and insipid, it is very little hunted, and therefore it is plentiful in many parts of the colony.

The length of the full-grown animal is about five feet, and the height both at shoulder and croup about half that measure. The horns of the male are from nine inches to a foot in length, with a few obscure wrinkles or annuli on the basal third, but exceedingly smooth, and tapering finely to keen points throughout the remainder of their length. They are indeed so sharp, so firm in their substance, and taper so gradually, that the natives use them for bodkins and even for needles.

The ears and tail, both of which are nearly naked, are about six inches in length, the head from the horns to the muzzle is about the same, gradually tapering, and the muzzle is small and black. The hair is of a soft woolly texture, approaching the nature of fur, beautifully formed into distinct curly locks in the young animals, but less so in the mature ones. The general colour in the upper part is reddish-ash, of varying tint as the light plays upon it, which is found to be produced by the individual fibres being coloured with a series of wings of ashen-grey and reddish-brown. The prevailing colour on all the under part is white, and so also are the chin and the margin of the lips, but the nose is brown, and the forehead and chin light fawn-colour. This species exhibits considerable varieties of colour, which may have led authors to describe different specimens of it under different names. It is questionable indeed whether it is not subject to a seasonal change of colour; and it is certain that while the legs of the adults have short smooth fur, those of the young have it reduced and curled into small locks.

The Reitbok (*A. eleotragus*). This species, as its name of reedbuck implies, frequents places which abound with reeds, such as the banks of streams and torrents when these contain water, and the beds of them after they have become dry. It is not common in the immediate neighbourhood of Cape Town, but in the interior it is not rare, though it shifts about and is never met with at any great distance from water. These antelopes do not flock, but they are sometimes met with in small packs, though more generally in single pairs; and as they are generally concealed



The Reitbok.

among reeds and other tall herbage, whether green or withered, they are not often seen in proportion to their numbers. Whether it be owing to difference of exposure to the weather or to some other cause has not been clearly ascertained; but it is generally agreed that these animals differ more in the general tints of their covering than any other of the antelopes. On that account they have received different names, but without any other foundation than mere differences of colour.

The reitbok is rather a short than tall animal, being half a foot shorter than the rheebok, but standing three or four inches higher on the legs. The head and tail are both long for the size of the animal, the former being ten inches from the muzzle to the roots of the horns, and the latter an inch more. The horns are peculiar, and at the same time very elegant. They are round, have prominent annuli toward the bases, the hollows between which are beautifully striated. They rise and continue, for the annulated portion, nearly in the line of the forehead, or with a very slight inclination forwards. The remaining or smooth portions bend forwards and a little downwards at the tips, so as to form hooks directed to the front, and it is probable that the animal makes use of those hooks in pulling down the tall reeds and other plants by the margins of the waters, so as to enable it to feed on their tender tops. The general colour of the body is a uniform dull ash-grey, but after red, and sometimes inclining to silvery. The throat and some of the under parts are generally silver-grey, and there are generally some spots or markings of black on the head. The hair on the lower part of the neck, the sides, and the tail, is long and somewhat shaggy. The females are of smaller size than the males, and without horns, but they are very little different in colour.

The Klipspringer (*A. oreotragus*) is a small and wonderfully fleet species, equally remarkable for the boldness of its adventures and the inaccessibility of its haunts. A figure of it is given in the background of the plate "Antelopes," in the attitude of taking a bound from one cliff to another, which it often does to great distances, and over the most frightful chasms. Its feet are so sure, that it can either spring from or alight upon a point of rock which does not appear as if it could afford footing even for a bird. It is the only antelope hitherto discovered in any other part of the world which rivals in command of the rocks the chamois of the Alps.

The entire length of the klipspringer is rather more than three feet; the height at the shoulder, twenty-one inches, and rather more than two and twenty at the croup. The head is small, narrow or compressed laterally, and the front is depressed immediately below the orbits, and terminates in a very slender naked muzzle of a black colour. The body is very compact and round, and the muscles of the shoulders, and especially of the haunches, are very vigorous and strongly marked. The legs are clean made, but much more robust than those of the majority of antelopes of the same size. The hoofs are singular, unlike those of any other animal. They are perfect cylinders, and the pastern joints are so rigid, that cannons, pasterns, and hoofs appear as if they were one continued straight line. There is thus no sort of lateral strain upon any of the joints of the feet, and wherever the foot catches, it holds on the point of the hoof, like a spiked pole. The prints of the hoofs on the ground, when it does walk on surfaces so soft as to receive that impression, are unlike those of any other cloven-footed animal. But it seldom quits its native rocks, as its powers of walking are very inferior to its powers of leaping.

The general colour of the upper part is yellow and green, each fibre partaking of the two colours in different portions of its length. On the sides the hair is long, thick, and standing out, so as to defend the animal from the collision of hard points. On the upper part of the head and neck it is very singular, each hair being a hollow tube, and the whole so fragile, that it breaks with a very slight touch. The general colour of the under part is brownish-yellow or yellowish-red, and that on the legs and head is brownish and short and smooth. The horns of the male are about three inches and a half in length, with small annuli at the base, and smooth for the rest of their lengths. The haunts of klipspringers necessarily expose them to the depredations of the larger birds of prey, though for the same reason they are safe from beasts of prey. Its flesh is much esteemed, and also its hair for stuffing cushions of various kinds. For these reasons it is much hunted; and though it sets dogs at defiance, it forms a conspicuous mark for the musket. It was once abundant in the rocky wilds of the colony, but it is now comparatively rare.

Such is a short outline of the principal species of antelopes, of which satisfactory accounts are to be met with; many more have been mentioned by authors, some upon questionable, and all upon rather imperfect authority. These have in general been omitted as of little use for popular purposes; and it may be added, that it is by no means probable that all the antelopes of central Asia and of Africa have been discovered, or that all which are now described as separate species deserve to retain that character.

As the article has extended to considerable length, some advantage in the way of reference may be derived from the following

ALPHABETICAL INDEX.

ANTENNÆ (literally what is borne in advance and crosswise). Certain appendages attached to the heads of many articulated animals, especially the insects and crustacea. In insects they are generally two in number; but the crustacea often have four. They vary much in their forms, and also in the proportions which they bear to the size of the animals; but they are symmetrical, that is to say, those on the one side of the head are always counterparts of those on the other; and when there are more than two, each pair is symmetrical; and wherever they are situated, they are equally distant from the mesial plane of the animal. They often differ in the two sexes; but among insects, at least, their form is pretty constant in the same species, so that they are much employed as a means of specific distinction; and some naturalists have proposed to make them the basis of larger divisions. As characteristic of species they are very convenient, because they are easily seen, and scarcely two species have them exactly alike. But the characters founded on them are purely artificial; the uses of the antennæ being very little known, or rather not known at all with anything like certainty. Still, from their universality among animals so very numerous, and their always being in a state of repose when the animal reposes, and of excitement when the animal is excited, they must answer some very important purpose in the economy of those creatures to which they belong.

In general they are susceptible of a considerable degree of motion, and of motion which is peculiar to themselves, and internally they are furnished with a considerable portion both of muscular fibres and of nervous tissue. In some insects they are flexible in their general external covering; but they more frequently are jointed, or consist of a number of pieces, stiff throughout their length, but moving freely upon each other and also upon their articulations with the head. Those joints or pieces vary very considerably in number, and also in form. Sometimes they are cylinders, and the whole of each antenna is nearly of uniform thickness. Sometimes they increase in thickness towards the points, and in other cases they diminish. In some again, each joint is swelled out in the middle, so that the antenna appears like a chain of little balls. In other instances again, they have projecting processes which give them a comb-like appearance, and in others they are beset with small bristles or with little feathery appendages. In short, their forms are so various that a large volume would be requisite for giving even the slightest account of them all; and though such a volume were written, it would be of no value, inasmuch as, not knowing the use of antennæ in any one of their forms, it is impossible even to guess at the different uses of the differently formed ones. We have already said that they are largely employed for specific distinction; and in the present state of our knowledge they are of no farther importance as a portion of the history of living creatures.

They are sometimes popularly called "horns," and also "feelers;" but the use of both these terms is objectionable, as both of them tend to give a wrong meaning; while the word antennæ has the advantage of having no meaning at all, and is of course the very best kind of name for any thing of the uses of which we are ignorant.

The projecting appendages to the heads of many of the mollusca are called horns, and they have probably some uses similar to those of antennæ; but they are retractile, and antennæ are not. The notion generally attached to horns, however, is that they are in some way weapons of offence or defence, purposes to which no antennæ are applied or capable of being applied; and indeed, whatever may be the real use of these organs, it is certainly not, in any way, mechanical.

The term "feelers" is still more objectionable than "horns," because it involves a theory of the use of the antennæ, and a theory for which there is no foundation whatever in nature. That theory of course is, that they are organs of feeling, and that those animals which have antennæ examine and know objects by means of them.

There is a double error in this gratuitous theory: in the first place, a direct faculty is given to the antennæ, which there are no means of proving that they possess; and in the second place, it is assumed that feeling is a direct and original means of knowing external objects, which is a very doubtful, or, in truth, a very erroneous supposition, even in the case of man, and in the case of other animals of course still more perplexing.

That sense, or faculty, or feeling in man, to which the common writers on physiology usually give the name of touch, and describe as residing in the papillæ of the skin, especially of the fingers and palms, is not a simple sense, at least when we consider it as a means by which the knowledge of external things, or of what we call their tangible qualities, is acquired. As a mere sense, it could communicate to us the knowledge of nothing but a peculiar kind of feeling, and the ascertaining of what that feeling was would be a mental process, consequent to the feeling, but not arising out of it or in any way dependent upon it as a mere animal sensation. If this were not the case we should be able, of our animal nature alone, and without the slightest effort or application of mind, to feel ourselves into the perfect knowledge of figure and magnitude, that is, of the whole science of Geometry. Now so far is this from being the case, that we may continue touching and fumbling at bodies of all sizes and forms for the whole length of our lives, and not only so, but we may in every case exercise the common act of thought which is exercised by the ignorant about every thing they handle, without ariving at the knowledge of a single geometrical truth. But if our sense of touch, as we call it, cannot convey to us a knowledge of the figure and magnitude of that which we touch, it is difficult to see what knowledge it can communicate. It may be said that it communicates the knowledge of heat and cold, of roughness and smoothness, and a few other states or qualities of matter which we very erroneously ascribe to it. But when we come to analyse them, even in the slightest manner, we find that the knowledge of heat and cold, roughness and smoothness, and all those other states and properties of bodies of which we are in the every day habit of saying we acquire a knowledge at once by touch, are, in truth, not sensations of any kind, but the results of mental comparisons, either of the state of a thing with the part of the body with which the thing comes in contact or comparisons of one thing with another. In us therefore the sense which we call feeling or touch, considered as a mere affection, or change of state (for that is all which it amounts to) in the animal organ really gives us no information whatever, until the intellectual part of our system takes it up, and by analogy, that is, by comparing it with our past experiences, elaborates it into knowledge; and if we had not the intellectual system thus to take it up and render it useful, the animal feeling would be a property given in vain—generally speaking, a source of pain and torture to us, and therefore quite inconsistent with that wisdom and goodness of which we find the traces so visible in every part of nature.

Now, even those who have a lingering desire to take chimpansees and ourang outangs into the pale of rational nature, never go so far as to bestow that "inferior sort of reason," of which they are so charitable to their favourite beasts, upon a black-beetle or a cabbage-butterfly. It is true that they who are thus votive of the sort of demi-rationality, or whatever other fraction it may be, do not thereby squander the property of others; because that which they give is wholly of their own invention and making, and therefore they have a right to bestow it as they list; and it is probable that the showman, who exhibits the "industrious fleas" for his bread, is just as ready to ascribe intellect to them as the man who exhibits an elephant for the same purpose, whether in a den or on a stage, is to ascribe it to the beast of his choice. We laugh at the recollection of the ancient Egyptians, and at the accounts of those castes in India, who made or make a sort of inferior divinities of animals without much regard either to their sagacity or their other good qualities. But truly the great majority of our writers do the very same in almost every page of the treatises on natural history.

But to return to the apes and the insects, in order to see clearly the absurdity of regarding antennæ as organs of feeling. The apes, and indeed all the vertebrated, or, as we call them, the more perfect animals, have no antennæ—no organs appropriated for the express exercise of feeling or touch; and thus, in the implements with which mind should work, we find the butterfly and the black-beetle much better furnished than the chimpansee; that is, we find those animals to which nobody thinks of attributing mind, furnished with specific organs that have been shown to be of no use without mind; while those again to which many are so prone to concede the inferior sort of reason, have no such organs—nothing which can be regarded as expressly and exclusively the seat of touch, inasmuch as all their organs answer other and well-known purposes. Nay, even in man, where we readily admit the existence of mind, there is no separate organ of touch; and that which is called the tactual sensibility of the hands and fingers, appears to be, in truth, nothing more than one of those properties which, combined, render a man's hands so efficient to him in the earning of his bread. The notion of feeling (that is, touch, so as in any way to know the thing touched) must therefore be abandoned in the case of antennæ, otherwise the greatest absurdity and inconsistence must be admitted to exist in nature, which would be equally inconsistent with the analogy and the fact.

The other conjectures as to the specific use of those organs are equally destitute of foundation; and if it were not that they get repeated by ignorant compilers, and thus spoil the philosophy of natural history, the great beauty and the supreme utility of the whole, they would be very ludicrous. They put one very much in mind of the arguments of the two rustics at the fair, when the one laboured to convince the other that the proboscis of the elephant was a nose, and the other strove as zealously to convince him that it was a tail.

The younger Huber (whose father made some important additions to the natural history of insects) fancied that the antennæ, at least those of ants, were a sort of telegraphs, by which these insects could communicate with each other at a distance. To this assertion, in the case of the ants, there is only one little objection—the utter impossibility of knowing whether it is or is not the fact; but then there are very many species of insects furnished with proportionally larger and more elaborately formed antennæ, which spend the greater part of their time under stones, below the surface of the ground, or otherwise in concealment; and of these not a few come abroad only in the dark, so they could not by possibility make the least use of their telegraphs. The telegraph system must therefore be given up, not as so faulty in philosophy as that of the feelers, but as being very palpably absurd in fact.

There is a third conjecture, which, though it has been made, and is sometimes still supported by learned professors, seems very fit company for the other two. The gist of it is, that the antennæ are organs of hearing, a curious sort of ears as it were. But, truly, organs consisting of a series of horny tubes, jointed together, even though abundantly furnished with muscles and nerves, and susceptible of much motion, are so unlike any organs which are *known* to be ears, that the assumption seems at first sight almost as ludicrous as if one were to maintain that the pincher claws of crabs and lobsters are wings. But attempts have been made to demonstrate the assumption by observations. A certain learned Swede was one day examining through a small telescope a nut-weevil, which was in a state of repose, with the antennæ flaccid and drooping. The professor made "a loud sound," and the weevil pricked up its antennæ, and was off in an instant. How loud a sound, or of what particular tone or intonance, the professor was capable of giving out, is not recorded; but the writer of this article has again and again observed insects during very loud peals of thunder remain perfectly quiescent, and never once prick up their antennæ, or give the least sign of hearing by means of these organs. When a musket is fired, too, it raises all the birds which are in the tree or the coppice, as it may be; but nobody ever heard of the mere report of a musket raising all the butterflies, or especially bringing out all the moths. But the external ears of birds are small, and sound may be regarded as in some sort deadened to them by the feathers of the ear coverts; therefore if antennæ *were* ears, in the common acceptation of the term—and if that is not made out there is really nothing made out—the moths, as having proportionally the largest ones, should be the first to start at the noise, and all the butterflies and beetles should be on the move long before a single bird moves a wing. The other supposed proofs of the hearing faculty of the antennæ which have been adduced are not better than that of the Swedish professor, but it is only justice to the parties to say that they are not worse.

It may seem trifling to enter into any thing like a refutation of assertions which are so completely without foundation, and in the judgment of common sense so ludicrously absurd; but they originate with those who, upon other points, claim the confidence of mankind, and thus they come in for their share of that confidence; and so, upon the strength of the other parts of the characters of their abettors, they do their full share of mischief to the young and the ignorant; hence, upon all subjects of which we are totally ignorant the greatest service that can be done, both to the unwary and to those who are seeking for knowledge, is to clear away the rubbish.

Under this impression, the writer of this article has observed and examined, with perhaps more care and attention than the subject deserves, to ascertain whether there is any invariable connection between sound and the excitement of the antennæ of insects, apart from or preceding the excitement of the insects themselves; and though, not knowing what it was, he cannot say positively that he has tested the talismanic sound made by the Swedish professor, yet he must say, that in all his observations there has not appeared the smallest tittle, even of presumptive evidence, that antennæ are ears. They are excitable organs certainly; but by what they are excited, and for what purposes, are points yet to be ascertained.

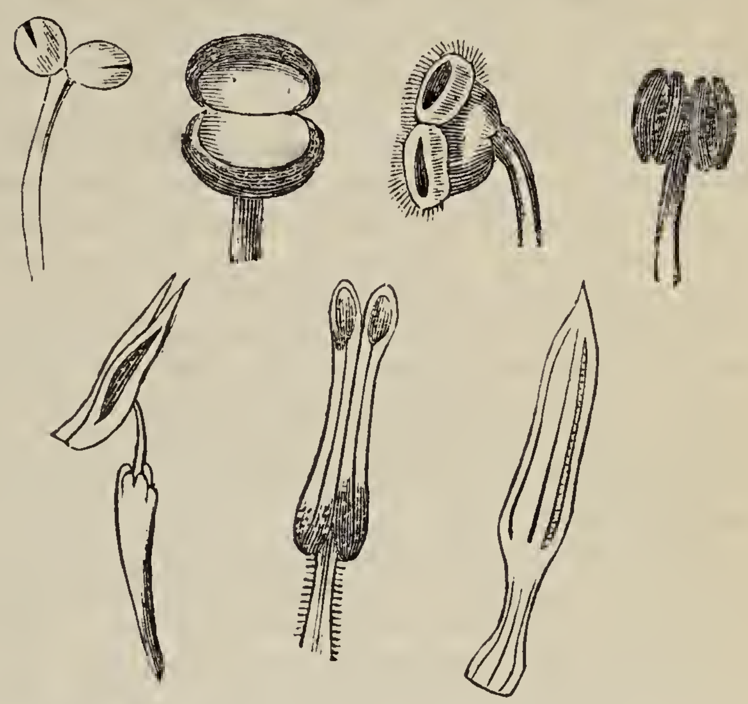
There is another argument which bears strongly against the hearing faculty of those organs; and that is, that many of the crustacea which are furnished with them are inhabitants of the water, of which even the vertebrated inhabitants are generally without any external ears, and such as have them have very small openings without any projecting organ; and it seems doubtful whether those openings are the inlets of what we call sound or not. It is true that fishes are provided with certain porcelainous bodies which have been supposed to be in some way connected with a sense so far resembling that of hearing as it is possible for a sense acting in water to resemble one of which air is the direct and proper medium. But these bodies in fishes are internal, and that they are connected with any kind of sensation is an assumption and not a fact; and though it were the latter, that would not establish any necessary correspondence in use; the truth is that the senses of the invertebrated animals, with the exception of sight, of which the organs, though often peculiar, are not easily mistaken, is one of the most obscure portions of natural history. See INSECTS, and the other divisions.

Various forms of Antennæ.

The above figures show the leading forms of antennæ.

ANTHER (the fertiliser) is the name given to that part of the stamens of flowers which first contains, and afterwards discharges the fertilising dust or pollen necessary for perfecting the ovulæ in the germen or seed-vessel. The anthers are generally supported by slender thread-like bodies, hence called filaments, to which they are attached, either by their base, or back, or by a single point at the centre. They differ very much in form; on some plants they are globular, oval, or hemispherical; on others arrow-shaped, cruciform, horned, or twinned. In colour they are mostly yellow, though often partaking of the general colour of the flower; blue, or red, or purple, and frequently of pearly white. The manner of their dehiscence, or opening to allow the escape of their contents, varies in different plants. Sometimes the anther bursts by a longitudinal suture, the skin or cuticle being rolled back; in other cases the pollen escapes by pores at the base, or at the apex of the cells; or is thence discharged at a lateral opening with some force and to considerable distance. In all unisexual flowers it is worthy of remark that the anthers are commonly placed above, or nearly equal in height with the stigma; and that these two essential organs of the flower become simultaneously perfect, so that their functions respectively may not be neutralised. In bisexual flowers it is also observable that the males have a higher station, or precede the females in development. In the larch and some others of the coniferæ, and among amentaceæ, it is seen that while the female catkins are erect, the males are pendent: so wisely has nature provided that her purposes of reproduction may not be defeated. How conspicuously is this circumstance shown in the zea mays, or Indian wheat? The male panicles are profusely covered with perfect anthers occupying the summit of the plant, before the tuft of thread-like stigmas come forth below. Indeed, the sexes are so distant, or rather the one comes forth so long before the other, as to induce the idea that the pollen finds its way to the stigmas through the vascular structure of the intervening stem. However this may be, the influence of the pollen is duly received, as is evinced by the regerminating powers of the produce.

Flowers are said to be not only robbed by bees of the honey exuded from the bottom of the corolla, but also of the pollen of the anthers, which they knead into wax for the construction of their combs. These thefts may be well excused, because, while these industrious insects are extracting honey and pollen, they are at the same time distributing the latter to accidentally misplaced or distant flowers which, without their bustling visits, might remain unfertile.



Differently formed Anthers, some of them magnified.

The above figures are some of the most common forms of anthers, and which will sufficiently identify these organs to the uninitiated in botanical knowledge; more especially when connected with the descriptions of the other parts of flowers with which the anthers are united. See STAMENS, POLLEN, &c.

ANTHERICUM (Linnæus). A large family of herbaceous plants, chiefly natives of the Cape of Good Hope. Linnæan class and order, *Hexandria Monogynia;* natural order, *Asphodeleæ.* Generic character: perianthium of many parts; corolla of six spreading petals; stamens below the germen; filaments awl-shaped, glossy; anthers leaning, two-celled; germen with three nectariferous glands; style awl-shaped; stigma somewhat clubbed; capsule three-celled; seeds three-sided.

The anthericums are greenhouse plants, and are readily flowered, but possess no great beauty.

ANTHOCERSIS (Labillardière). A family consisting of three species of evergreen shrubs, from New Holland. Linnæan class and order, *Didynamia Angiospermia.* Natural order, *Solaneæ.* Generic character: calyx five-cleft; corolla bell-shaped, but pressed together at the base, throat ribbed, limb in five equal parts; stamens included, with five rudiments; filaments flat at the base; anthers ovular and two-celled; style with a two-lobed stigma; capsule two-celled, two-valved; seeds netted.

ANTHOLYZA (Linnæus). A small, but an exceedingly beautiful genus of Cape of Good Hope bulbs. Linnæan class and order, *Triandria Monogynia.* Natural order, *Irideæ.* Generic character: spatha, of two valves, somewhat convolute; corolla, tubular, elegant, limb gaping, upper lip elongated, the lower cut into five segments; side ones reflexed; stigma undivided; capsule globular, leathery; seeds round, barked. This is one of the most interesting of the Cape bulbs, and is usually treated as a frame plant, and kept in pots. Like other bulbous and tuberous plants, they require to be kept very dry when in a dormant state. There are three species.

ANTHOPHYLLITE. A massive mineral of a brownish colour; sometimes also crystallised, in thin, flat six-sided prisms, streaked lengthwise. It has a false metallic lustre, glistening and pearly. Its crystals are transparent, but not sufficiently hard to scratch glass.

ANTHOXANTHUM—spring grass. One of the most useful of our pasture grasses, belonging to the Linnæan class and order, *Diandria Digynia*. Natural order, *Gramineæ*. Generic character: panicle formed like a spike; calyx, two-valved, three-flowered; corolla two inferior one-valved bristles; middle two-valved perfect, valves unequally acute; stamina, filaments like hairs; anthers, two-celled; styles, two, hairy. The sweet scent of hay is attributed to the presence of this grass; but although this is not entirely the case, it is certainly one of our sweetest grasses. There are four species all cultivated; but the difficulty of cultivating the seeds renders it rather costly for extensive use. It is one of the most early grasses, flowering early in April, and hence its name.

ANTHRACIDÆ (Leach). A family of insects of the order *Diptera;* the characters of which are, body short; wings spreading widely out; antennæ distant, and two sometimes three-jointed; the head as high as the thorax. Stephens, in his Catalogue of British Insects, enumerates two genera as belonging to this family, and found in England. The *Lomatia* of Meigen and the *Anthrax* of Fabricius; to the accurate pen and pencil of Curtis we are indebted for the natural characters of Anthrax, which illustrates the 9th plate of his "Illustrations of British Entomology"—antennæ projecting, remote three-jointed, the first joint cylindrical, and club-shaped, twice the length of the second, with long and thick tufts of hair; the second is nearly globular and hairy; and the third nearly naked, somewhat pear-shaped, with a long style terminated by a tuft of hair, the style being one or two-jointed; maxilla horny and acute, nearly as long as the labrum; palpi two, which are received into the cavity of the mouth, simple, cylindric, hairy, attached to the side of the maxilla near the base, half their length; mentum cylindrical, hollow above, to receive the tongue and labrum. The lips fleshy, oblong, and extend as far as the tongue.

The A. *ornata* (Hoffmansegg) is black and shining; the head covered with black hair between the eyes, silvery behind, clypeus and under side of head with golden hair; thorax covered with ochreous coloured hair before, nearly naked in the centre; scutellum brownish; abdomen covered with short golden hair, the sides being surrounded with alternate fasciculi of fine white and black hair; third and fourth segments with white fasciæ interrupted in the middle; sixth with a white spot in the centre; last joint very white with hair; wings transparent, with numerous nerves, and having a brunneous cloud extending two-thirds the length, situated at the posterior margin, with a transverse transparent spot near the base, a larger one in the centre, and two others near the margin at the union of the nerves. This species was first discovered by J. C. Dale, Esq. at Parley Heath, on the borders of Dorset and Hants, in July 1821, and afterwards in September 1823. It was found settling upon heath, banks, and on the ground where the turf had been pared off; it has also been captured by Mr. Bentley in the same neighbourhood. Another species, *A. flava* (Hoffmansegg) was also captured in the beginning of July 1822, flying amongst rushes, and alighting upon the sand near the sea-shore at Covehithe, Suffolk, and *A. circumdata* of Hoffmansegg has been taken in Devon on the borders of woods in June; they are all very rare, and the only species known to inhabit Britain.

The anthracidæ fly in the sunshine and subsist on the juices of flowers.

ANTHRACITE. This mineral, which is now employed to a considerable extent as a substitute for common fuel, especially in the burning of lime, very much resembles coal in its external appearance. It is sometimes called glance-coal, from the German word *glanz*, which it derives from its glistening lustrous character. Anthracite burns without flame, and contains more than ninety per cent. of pure carbon, so that it may in fact be considered as mineral charcoal..

Mr. Weaver, in a paper on the geology of the south of Ireland, has described vast beds of anthracite occurring in clay-slate and grey-wacke. He says that the most considerable collieries have yielded 25,000 tons annually, and adds, that all the coal of the province of Munster, with the exception of that of the county of Clare, is of the same sort. It is remarkable, too, that the anthracite, and a slate highly charged with pyrites, which accompanies it, are full of impressions of plants of the fern tribe, such as *equiseta* and *calamites*, analogous to those found in the true coal formations; this is an important circumstance with reference to the history of anthracite, and gives strong countenance to the opinion that this substance, even in the oldest of the stratified rocks, is of vegetable origin.

That species of anthracite termed slaty glance-coal, is found in several floetz districts in Scotland, especially in West Lothian, Fifeshire, and Ayrshire, and in the island of Arran. In similar rocks in England, as in the southern parts of Brecknock, Caermarthen, and Pembroke; and near Walsal, in Staffordshire: also at several places in Ireland. On the continent it is met with at Kongsberg in Norway, where it is associated with native silver, in veins that traverse mica-slate: in the Hartz, in veins of red and brown iron-ore, which traverse grey-wacke; and in mineral veins at Schemnitz in Hungary. It also occurs abundantly in the United States of America.

ANTHROCOTHERIUM. A genus of fossil, extinct, *Pachydermata*, for the discovery of the existence of which we are indebted to the researches of the baron Cuvier. This genus appears to have held an intermediate place between the *palæotheria*, *anoplotheria*, and swine. The teeth exhibit many points of agreement with the *anoplotherium;* but the large and projecting canine teeth leave no doubt of its having been a perfectly distinct genus. Two species were found in the lignites of Cadibone, near Savone, and a third in the fresh-water formation in the environs of Agen. The first approached the rhinoceros in size, the second was considerably smaller, and the third rests upon the fragment of a jaw exhibiting certain peculiarities, which was found in the department of Lot et Garonne.

ANTHUS—Pipit. A genus of insectivorous birds, having in their general characters no inconsiderable resemblance to the wagtails; but not being so exclusively insectivorous in their feeding as these, and not so aquatic in their habits. Their haunts are various, some of them resorting to the open fields, others to the vicinity of woods, and others again to the shores of the sea; but in all their differences of locality they are ground birds, nestling upon the surface of the earth, and finding the greater part of their food there. They are not migrants, but they live dispersedly in the summer and the breeding season, retiring at that time to a distance from the habitations of man and the cultivated grounds. When their broods are fully fledged, and the old ones have undergone the moult, during which they lose the peculiar colours of the breeding time, they flock to the cultivated fields; and they have, under these circumstances, sometimes been confounded with the larks, a genus of the distinguishing characters of which they possess none. The larks have the claw upon the hind toe very long and nearly straight; the pipits have the same claw, but shorter and crooked. The following are the generic characters of the pipits: the bill straight and slender, slightly conical in the basal part, but compressed laterally about the middle of its length by a slight turning inwards of the tomia or cutting edges, and awl-shaped toward the tip. The upper mandible has a ridge or keel along the middle, is slightly turned downwards at the point, margined, and with a mere rudiment of a notch. It is thus less insectivorous than the bills of most of the order, but still it has neither the form nor the strength of a seed-eating bill. The nostrils are lateral at the base of the bill, and in part covered by membrane. The feet have three toes before and one behind, the outer one of the first joined to the middle as far as the first joint, and the claw on the hind one more or less produced according to the species, but always considerably hooked. The wings are of moderate length and rounded, the first quill being very short, and the second shorter than the third or fourth. In the closed wing, some of the greater coverts are as long as the quills. For an account of the more interesting species, especially the British ones (of which there are three), see the article Pipit.

ANTIMONY. This metallic body, in a native state, is usually divided into two species, the dodecahedral and the octohedral. The first of these is of a white colour, occurs massive, and is found in argentiferous veins in the gneiss mountain of Chalanches in Dauphiny, where it is accompanied with grey antimony, white antimony, red antimony, &c.; at Andreasberg, in the Hartz, associated with red silver, calcareous spar, and quartz; at Sahlberg, in Sweden, disseminated in calcareous spar. It is also found at Cuencamé, in Mexico.

The octohedral antimony is sometimes divided into antimonial silver and arsenical silver; but by chemical analysis it is found that the antimony really forms but a very small proportion of the entire mass in either case.

Antimony-glance (*speizglas*, Mohs) contains three species, prismatoidal antimony-glance, axifrangible antimony-glance, and prismatic antimony-glance. The first of these is divided into two sub-species, the common grey antimony and plumose antimony. The axifrangible antimony-glance is of a blackish lead grey colour. See BOURNONITE.

The prismatic antimony-glance is of a similar colour to the preceding, and possesses a metallic lustre.

Antimonial ochre is found in Cornwall, and in several places on the continent of Europe.

Antimony-blende, or red antimony. The species best known of this form of antimony is of a cherry-red colour; the primitive form is an oblique four-sided prism. It occurs in veins in primitive rocks, generally along with native antimony, grey antimony, and ores of arsenic.

Berzelius places antimony amongst the electro-negative metals, that is, metals whose oxides rather act as acids than bases in the compounds they form with other oxidated bodies.

The sulphuret of antimony is the only abundant ore of the metal. When this is heated in contact with iron, the sulphur, on account of its greater affinity for that metal, is separated by it from the antimony, which is consequently reduced to the metallic state.

ANTIPATHES (Ellis, Lamouroux). A fixed sub-dendroidal polypidom, composed of a central axis, and a corticiform crust, the axis is flattened and fixed at the base; it is subramose, horny, solid, flexible, rather fragile, and mostly set with small spines.

The cortical crust is gelatinous and polypiferous, covering the living axis and branches, and falling off on the removal of the specimen from the water. They are found in the European seas.

AOTUS (Smith). A genus of three species of greenhouse evergreen shrubs, from New Holland. Linnæan class and order, *Decandria Monogynia*, natural order, *Leguminosæ*. Generic character: calyx ebracteated, five cleft; corolla of nearly equal petals; stamina, subject to fall; style erect, thread-formed, enlarging above; pod two-seeded.

APARGIA (Scobel). A genus, consisting of nineteen species of herbaceous plants, natives of Europe. Three of them are found in Britain, known by the name of Hawkbit, and easily detected by the hairs of the receptacle rising conspicuously out of the top of each plant, they belong to *Syngenesia æqualis* Linnæus; and to the natural order, *Compositæ* of Jussieu.

APE—*Pithecus*. A genus of quadrumana, or four-handed mammalia, and the one which, in its structure, both external and internal, is described as making the nearest approach to the human subject. *Pithecus* is certainly less objectionable for the systematic name of the genus than the Latin *Simia*, because it was applied only to the tailless apes by the Greeks, whereas *Simia* was applied to all apes, or to all the quadrumana known to the Romans, whether they were destitute of tails or not. The other and probably original meaning of the Greek word (*pithecus*) is also less objectionable. It signified "a dwarf," without any allusion to character, whereas *simia* was applied to persons who had more of the trifling mischief of the monkey in them than of the demure gravity of the ape. Both names are, however, thus far exceptionable, that they point to a comparison between these animals and man; and, in consequence of that, the natural history of apes has continued, up to the present time, to involve more absurdity, even in the hands of scientific naturalists, than that of any other genus of animals.

The structure of the different species of apes has indeed been examined with the minutest attention, whenever that could be done; and the conduct of the animals has been observed with much attention, and recorded at great and sometimes ludicrous length; and yet, though Europeans have captured or endeavoured to capture every ape they have seen in those countries where apes reside, there are very few animals of the habits of which in a state of nature we know so little. The fault has lain in the structure of apes not being studied with reference to their own haunts and habits in a state of nature, but to find out what species has the greatest resemblance to man. This is trifling, certainly; but it is any thing but philosophic trifling. Structural resemblances to man can be traced in many animals—in the sloths, for instance, and the bats—nay, even in the whales, the bones of whose swimming paws have a very considerable resemblance to those of the human arm and hand.

At best, the tracing of such analogies is waste of time; and at worst it leads, almost as a matter of necessity, the ignorant to materialism, inasmuch as it tends to show that the only superiority of man over the other animals is what the parties in question call a superior organisation. Now, in the rational view of the matter, there is no superior organisation. Each animal has to perform certain functions specifically different, if the animals can be considered as different species; and in each the organisation is better fitted for the performance of its own function than that of any other animal; and therefore as regards that function, which may be considered as the purpose of the animal in nature, its organisation is higher than that of any other. What the animal does, and how it is organised for the doing of it, are the valuable points in the natural history of any one animal, be it of what class, order, family, genus, or species it may; and to find out how the function and the organisation vary together, as we pass from species to species, is the valuable point in the comparison of one with another.

When we pursue our observations and analogies in this way, the conclusions at which we arrive are of the greatest practical utility. In one respect, we find out the means which are best adapted for the accomplishment of purposes; and as the purposes of animals, that is the actions which they perform, are absolutely countless, there is not a difficulty we can meet with in any mechanical art, in which we shall not get assistance from the structure and functions of animals, if we seek it with due knowledge and without prejudice. Again, if, along with the organisation, and the functions which that organisation performs, we take the dispositions of the animals, and the circumstances which promote most their health and duration, we ascertain the capabilities of the animals, the uses to which we may apply them, as their flesh for food, their skins or the appendages of them for clothing, their strength for labour, and their docility for other services. Such are the practical results of the proper study of animals; and when arrived at by proper means, that is by careful observation and unbiassed inference, no results can be more valuable.

But when, as has been very generally done in the case of the apes, we quit the proper ground of natural history, and seek for analogies where, in the nature of things, no analogy can possibly be found, we not only destroy the proper usefulness of natural history, but we turn it into a source of the most pernicious error, because it is error which leads us to a misunderstanding of our own nature.

If, in proportion as the apes approximate to man in the structure of their bodies, they also approximate to man in the actions which *of themselves* they are capable of performing, then it is impossible to prevent this question from arising to all persons, especially young persons, who are in the anxious pursuit of knowledge and truth:—"If other animals approximate to man in capacity, in proportion as they approximate to him in organic structure, and if the superiority of man depends on his organisation, what possible use can there be for *mind* in man—for an immortal spirit totally and essentially different from all else in the animated creation?" And if the premises are admitted, the answer is irresistible:—"There is no use for such a mind; and by the received law of nature that 'nothing is made in vain,' no such mind can by possibility exist." Such is the doctrine even now broached under the real or pretended authority of names, sounding enough to give currency, and, among the ignorant, reception as truth, to any error! This, however, is a cruel deception, and the responsibility cannot be got rid of by that "easy virtue," whose plea of justification may be that it is "feeding the hungry and clothing the naked."

The grand natural history argument for mind in man, and when properly stated it is quite conclusive, is, that of itself and without the mind to guide it, his organisation does not appear fit for any one thing. Go to the whole of the animal tribes, from the ape to the animalcule, and say whose place, if he had no mental resource, man could supply. Make yourself master of all his anatomy, understand the motions of every bone, and the action of every muscle, then say in what part of wild nature you would place him, so that he would, without mental resource, act his part better than any other creature which is there already, or even half as well as some one or other of them? You find all the animals allocated and peculiar, the best fitted for their localities, and fitted for them without any instruction: man is fit for nothing till he is taught; but with teaching he becomes equally fit for all things. This is a difference not of degree only but of kind; and it bars all useful comparison between man and the other animals. The length of the Thames to the length of a summer's day is not a more absurd comparison than that of man to an ape.

The group at the bottom of plate Apes, in which the burin of Thomas Landseer has brought out the form and the expression with equal force and truth, contains the two species with which the description of naturalists above alluded to have shown the greatest disposition to claim kindred. Some have preferred the metaphysical cut of the chimpansee, others the demure looks of the orang-utan; and from the attitude in which the artist has placed him, as if he were the judge in a cause or the arbiter in a dispute, he looks very wise; though others again may prefer the grave and wigged visage of the black gibbon. But all these differences of appearance are indications of differences in the habits and haunts of the animals, and of *nothing more*.

The distinguishing characters of the true apes are, having neither tails nor cheek pouches. Their teeth are the same in number as in man, and their incisive and grinding both resemble those of man in form, but the canines are large and prominent, and in the full-grown animals scarcely less formidable than the corresponding teeth of beasts of prey. All the paws (for it is incorrect to call them hands) consist of four fingers and a thumb. The latter member is, however, very small, sometimes without a nail, and cannot, in all of the species, be said to perform the functions of a true thumb; but often more resembles the callous pad, which forms a point of resistance against the fingers in several other climbing animals. The anterior extremities are long, but much longer in some of the species than in others; the fingers are also long, the bones of some of the phalanges are often curved toward the palms, and the muscular power in grasping or pulling is much greater than, from the size of the animal or of the parts, one would be led to suppose. Similar grasping powers, in proportion to their size, are, however, common to all the quadrumana, and to all climbing animals. The joints of the elbows, shoulders, and wrists, also admit of more motion than in man, and the grasping power of the fingers can be strongly exerted with the arm in many more positions, especially positions that are wide or outwards. The whole structure of the anterior extremities indicates that they are instruments for grasping in all directions round the animal, and to the greatest distance possible.

The posterior extremities are proportionally much shorter, but they admit of perhaps a greater range of motion, especially at the hip and ankle joints. The knee joints are naturally what are called "bowed," or bent outwards; but such is the motion of the hip joint that the thighs can be plaited across each other, or they can be widely extended, and at the same time rolled so far outwards that the toes (or fingers rather) are behind the line of the heels. The ankle joint is a ball and socket, only its motion is nearly confined to the inner semicircle. The sole of the foot cannot be turned outwards, and in some of the species it is, as in the sloths, not capable of being planted level on the ground; but it can turn inward till it is above the natural plane, backward till it is beyond the line of the leg, and upward till the whole upper part of the foot bears against the shin. The thumb upon these is usually short, articulated far behind the basal phalanx of the toes, and when not in action standing nearly at right angles to the axis of the foot. The toes of these extremities generally have the bones of the phalanges more or less bent; and in some of the species the first and second are united together, as if to give greater steadiness in grasping. The toes on the hind feet, even when they are all free, do not admit of separate motions; and that those of the fore feet can so move is alleged rather than proved. They cannot spread out their hands as man does, or even as is done by dogs and various other digitigrade animals.

Both anterior and posterior extremities are therefore grasping instruments, and proportionally ill adapted for walking; and though, where they do walk, some of them generally, and all of them occasionally, walk on the hind extremities only, they are unsteady and hobbling, and those species which are understood to be the best climbers, have the anterior extremities always ready to balance, support, or assist them as they wriggle along.

Apes, though any thing but handsome to look at, are still interesting animals, both on account of the peculiarity of their structure, and of all that has been said about their resemblance to man; and therefore it is to be regretted that little is known of their habits in their native localities.

They are confined to the eastern continent and its islands, and their haunts, even there, are limited and peculiar. One species only has been hitherto observed in Africa; and the others are confined to the south-east of Asia to Sumatra, Java, Borneo, and some of the other islands, but probably they extend to those portions of the Eastern or Malay peninsula which have a climate similar to that of the islands. They are not found in any of those parts which have the broad extremes of tropical climate, long droughts alternating with heavy rains. This appears to be the case both in Asia and in Africa, and furnishes us with, at least, one little point in their natural history: they are not migrants, but remain in the same locality all the year round, and that locality must, of course, be such as to supply them with a constant succession of food.

The animals of the American continent to which they bear the greatest analogy in their habits are the sloths; but the manners and food of the two differ, so that the climate, or, which is the same thing, the season, must differ in proportion. The sloths are organised for horizontal locomotion along the twigs, with their backs underneath, and they feed on the leaves above them, and repose hanging suspended under the branches; they cannot walk, sit, run, or lie upon the ground with comfort; the action of their extremities is powerful only when exerted towards the mesial line of the body. The apes, on the other hand, grasp all round them; they sit, they lie, and they can walk a little—some of them tolerably well. They are, therefore, not adapted for grazing on the leaves of trees as the sloths do, though admirably so for finding their way from branch to branch, and gathering fruits.

And the localities which the apes inhabit are exactly those in which there are always fruits upon the trees; where the same tree brings forward a succession of crops, and where the productive season of one species falls so well upon the unproductive season of another, that there is an abundant supply of food all the year round.

In this way, the ape, like the sloth, and indeed most localised animals, which naturally inhabit particular districts of the world only, becomes a key to the general character of those places where it is found; such places are never burnt up by tropical droughts, neither are they, for any length of time at least, deluged by tropical rains, because both of these are incompatible with perpetual fruitage. The Oriental islands, to which the greater part of the apes are generally, if not exclusively, confined, are nearly out of the range of the monsoons, which are taken in flank by the trade winds of the Pacific, so that they have a wonderful uniformity of climate, and part of the Malay peninsula has so much the same character, that the fruits of the Molucca islands are found in the woods of that portion of the coast which was ceded to the East India Company at the close of the Burmese war. One species of ape, the chimpansee, has been found in the woods of Africa, and from near the mouth of the Gambia to Angola, or along all that part of the coast which has permanent foliage and fruit; but most abundantly in the lower parts of the Congo and the Niger. From the comparative shortness of its arms, and its greater facility in walking, it is reasonable to suppose that this species climbs less, or at all events travels more, than the long-armed ones, which are such bad walkers. Hence it is probable that the permanently fertile zone of tropical Africa is inferior in productiveness to the Oriental isles.

But still it is by no means an unimportant point to ascertain that there is in Africa, near the parallel of the equator, a zone of perennial fertility, in which the chimpansee can find food all the year round ; and that there must be is corroborated by other circumstances. The river Congo discharges a very great volume of water; it never falls very low, and it never rises above nine feet, so that it must flow, in great part at least, through a country where the rains are comparatively frequent and moderate—a country desirable to inhabit and profitable to cultivate ; and one, by means of the waters of which a communication may at some period of time be established between the sides of Africa. Thus, imperfect as it is, there is some utility in the general natural history of apes.

It is tolerably well ascertained that the apes are all inhabitants of the forest, that they climb trees with great dexterity, and live upon fruits ; and, that they may examine all above and around them for these, is probably the original use of that habit of apparent observation of all that is going on which they have in a state of confinement. They are not understood to sleep clinging, but to make a sort of rude nests for themselves in the forks of trees, where they sleep during the night, and recline during the heat of the day, the morning and evening being, as with most animals of warm climates, their chief feeding times.

No very satisfactory conclusions with regard to their manners in a state of nature can be drawn from the few specimens which have been brought to Europe. These have generally been taken young, trained differently from what they are in a state of nature, and rendered dull and sickly by climatal and other causes. The inference from the character of all the rest of the order is, that they are mischievous, and their strong hands and formidable canine teeth certainly render them capable of much mischief. The data are too scanty for any positive general conclusion ; but it seems certain that they cannot be trained for any useful purpose ; and that, much as their resemblance to man is dwelt upon, they are far behind many other animals in that which is called animal sagacity. We shall now very briefly advert to the species.

1. Chimpansee (*Pithecus troglodytes*). Baron Cuvier gives the preference to the orang-utan ; and, in point of climbing, certainly in point of size, and, for any thing that we know to the contrary, in point of sagacity, it may deserve the preference ; but the matter is one of mere opinion. The chimpansee is, as has been said, found both in the Asiatic isles and in Africa ; and it is said to be of larger size and more handsome form in the latter country than in the former—that it has the arms shorter, walks more erect, and has the neck longer. These differences tend to show that the trees which have apes' food are of smaller growth and further apart from each other than in Asia ; and that, also, in part explains why none of the long-armed climbing apes are found in Africa, but have their place supplied by the baboons, which run well upon all fours, and are more ferocious in their dispositions. The very few specimens of the chimpansee which have been seen in this country have been all of small stature ; but they have been young, and we neither know the period which these animals require to attain their full stature, nor the circumstances by which their growth may be retarded or stopped. Travellers say that they attain the height of an ordinary man ; but there is reason to suspect that in that, as well as in some other points, their history has been confounded with that of the larger baboons. It is said that they live in small bands, and construct a series of huts for their common residence. The former is likely, as all apes are, to a certain degree, social ; but the construction of the huts is doubtful, as it has not been borne out by what has been observed of other apes, or even of the same species in the East. Nor do the tales of their running away with negro girls, for the purpose of stocking their seraglios, appear to be better founded ; and they are certainly against the general analogy of animated nature. The fact is, that the comparisons which have constantly been made between these animals and man, render it no easy matter to determine what portion of the reports which are given of them should be received and what rejected : and the chimpansee is not so very like man after all. The flat top of the head, the great round ears, and the short and scanty hair on the head, have nothing very human in their aspect. There is a ridge over the eyes, but it is not like an eye brow ; and the eyes have nothing human in their enfoncement or their expression. The nose is merely a ridge on the muzzle ; and the mouth, from the manner of its opening, as well as the extent to which it opens, is evidently intended for no purpose save that of biting. The lower jaw is not a chin either, in its anterior part, but merely a deep jaw, to afford insertion to the large teeth and the powerful muscles.

That the females have pectoral mammæ is no proof of approximation to man, because almost all animals which carry their young with them when they ascend trees have the same—invariably if they carry the young in the arms.

It does not appear that the differences which have been mentioned as existing between the chimpansees of Africa and of the Oriental isles are sufficient to constitute a difference or even a variety ; the more so that we are but little acquainted with the appearance and habits of the adult animals in either region. All that can be inferred is, that they have to climb more and walk less, and their arms are lengthened and their legs shortened and weakened in proportion. Even those chimpansees which are the best walkers, do not walk as man does, by advancing the leg while the body remains square to the front; they roll the pelvis, and the feet, instead of moving over straight lines, move over arches of circles, of each of which the opposite hip joint is the centre ; and even in them the feet are far more efficient in climbing and grasping than in walking, which shows that climbing is the grand motion for which they are organised ; and that just as much of the power of walking is added, as enables them to be the passing feeders upon fruits in those parts of the forests where the fruit-bearing trees are too small and far asunder for suiting the organisation of the long-armed apes.

The face and ears of the chimpansee are of a brown colour, and naked ; but the skin of the face, especially, is withered and leather-like, and has no resemblance to the human skin in texture and gloss ; it more resembles the naked parts of some reptiles, or those of the bats. The head, back of the neck, shoulders, and back, are covered with coarse black hair, rather long, and forming a sort of whiskers or tufts on the cheeks, but otherwise longest on the upper parts of the back. The arms have the hair inclining downwards from the shoulder to the elbow, and upwards from the wrist to the same, and these form a sort of ruff at the point of meeting. This position of the hair enables the fore-arm to be more readily thrust among the leaves, to pull the fruit. When there are hairs on the human fore-arm, they are not turned toward the elbow, but outwards, and inclining to the wrist. So that, down to the very minutest particular, we find in the ape adaptations to peculiar localities and habits, not one of which can be traced in man.

Even the trivial name of this species (*troglodytes*) is in some sort connected with gratuitous analogies, and as such calculated to mislead. In ancient times there was a race of people known by the name of *troglodytes*, or "dwellers in caves," said to inhabit somewhere in the vicinity of the Red Sea, and to be of small stature and deformed outline; and so strong was the prejudice, arising probably from this similarity of name, that Linnæus himself made man one species of the genus *homo*, and the chimpansee, which, of course, was not so well known to Europeans in his time as it is now, another, under the name of *homo troglodytes*. Now it does not appear that the chimpansee is *troglodytes* at all, inasmuch as it does not dwell in caves. It does not inhabit those regions in which the *troglodytes* of the ancients are said to have resided, and it is rather improbable that the ancients had any accurate knowledge of the places in which it is now found.

Orang-utan (*Pithecus satyris*). This animal, though more of a climber and woodsman, and more adroit among the branches than the chimpansee, has been much better known and understood. It is the one which the late Baron Cuvier preferred for taking the lead as next to man; and the chief difference is, that it is a much worse walker and more efficient climber than the chimpansee. It is found only in the deep and dense forests of the Eastern isles, and probably in that part of the Malay peninsula which has been described as having the same climate and the same natural character. It will be seen from the plate, to which we again refer as a faithful and characteristic likeness, that there is not a great deal of human character in this animal. The forehead is flat, the eye little enfonced, the muzzle much produced, the gape wide, the canine teeth (in the old animal) very large, the under-jaw without any form of a chin, the ears short, and with few convolutions in the concha, the neck very short, thick, and rendered apparently thicker by a pouch of skin on each side, which the animal distends when it screams or yells, or whatever else the noise it utters may be called. The anterior extremities are very long, so much so that when the animal stands or walks on the hind ones (such standing or walking as it can accomplish upon them), the points of the fingers touch the ground, and a very little bending enables it to walk upon all fours. The posterior extremities are just as disproportionally short, and they are so ill-adapted for walking that it is compelled to walk on their outer edges as the sloth does, because the sole cannot be so turned as to be planted on the ground; the leg and thigh bones are both very short; but with the exception of the incapacity for turning the sole of the foot to the ground, the motions of all the joints of the leg are remarkably true, and the muscles by which the bones are moved are very powerful. The ankle joints move like a wrist joint, and the foot is much more like a hand than in the chimpansee. They are still however hands, of which the chief power of grasping is in the fingers, for the thumbs are very short, and in some individuals they are without nails. The body is not so compact as that of the chimpansee, and the abdomen is larger in proportion. The face, ears, and hands are naked, not so dark, and more inclining to a dull red than in the chimpansee. The hair, too, which is long and coarse on the head, neck, and back, is of a deep purplish red, and so is that on the fore part of the body, which is but thinly covered.

In his native forests, and under what may be perhaps considered as the most genial climate in the world to all vegetables that are grown and all animals that are produced under it, the orang-utan becomes a very large and formidable animal. His height is not less than seven feet; his muscular strength great in proportion; and his bite, from the strength of his teeth and the depth of his gape, is very formidable. He leaps from the ground to the branches, and so from branch to branch, with great agility; and by the power which he has of grasping by the feet, swinging and balancing the body, and extending his long arms, he gets on from tree to tree with great ease and quickness. If, indeed, he ever gains the forest, and he is never found at any great distance from it, it is impossible to catch, and difficult to shoot him; and when wounded and irritated he makes a desperate resistance. It does not appear, however, that he is, in any case, the first to attack, neither does he stand on the defensive, till flight is no longer availing. He remains in his forest, and gathers his wild fruits in peace with all the less powerful inhabitants.

From the specimens recently brought to Europe no correct idea can be formed of the stature, the strength, or the energy of this animal in his native East. Nature has fitted him only for finding his food in the forests there, and also suited his constitution to that climate only. The young ones which are brought to Europe linger a while in a sickly state; but their powers are never developed, and they soon perish of disease.

It does not appear that this species, or indeed any of the true apes except the chimpansee, is found any where but in the south-east of Asia, which would lead to the supposition that the African forests are not so shadowy or so abundant in fruits as those of the Oriental islands. In those islands, the general habit of the orang-utan appears to be to conceal himself in the depths of the woods; but the following account by Dr. Abel shows that, while at home, or even while in health, these animals are social, and even playful. On his return from the East, Dr. Abel brought with him one which he had kept for some time in the island of Java; and the account cannot be better given than in his own words:—"While in Java," says Dr. A., "he lodged in a large tamarind-tree near my dwelling, and formed a bed by intertwining the small branches and covering them with leaves. During the day, he would lie with his head projecting beyond his nest, watching whoever might pass under; and when he saw any one with fruit, would descend to obtain a share of it. He always retired for the night at sunset, or sooner if he had been well fed, and rose with the sun, and visited those from whom he habitually received food. On board ship he generally slept at the mast-head, after wrapping himself up in a sail. Sometimes I pre-occupied his bed, and teased him by refusing to give it up. On these occasions he would endeavour to pull the sail from under me or force me to quit it, and would not rest till I had resigned it. If all the sails happened to be set, he would hunt about for some other covering, and either steal one of the sailor's jackets, or empty a hammock of its blankets. His favourite amusement in Java was in swinging from the branches of trees, or climbing over the roofs of houses; on board, in hanging by the ropes, or romping with the boys of the ship. He would entice them to play by striking them with his hand as they passed, and then bounding from them; but allowing them to overtake him, and engaging in a mock scuffle. Of some small monkeys on board he took little notice, whilst under the observation of the persons of the ship. Once, indeed, he openly attempted to throw a small cage, containing three of them, overboard; but I have reason to believe that he was not so indifferent to their society when free from observation. On one occasion I observed him lying on his back, partially covered with a sail, contemplating with great gravity the gambols of a young monkey which was bounding over him; at length he caught him by the tail, and tried to envelope him in his covering. The monkey seemed to dislike the confinement and broke from him, but again renewed its gambols; and though frequently caught, always escaped. The intercourse, however, did not seem to be that of equals, for the orang-utan never condescended to romp with the monkeys as he did with the boys of the ship; yet the monkeys had evidently a great predilection for his company, for whenever they broke loose they took their way to his resting-place.

"But though so gentle when not exceedingly irritated, the orang-utan could be excited to violent rage, and on one or two occasions committed an act which, in a rational being, would have been called the threatening of suicide. If repeatedly refused an orange when he attempted to take it, he would shriek violently and swing furiously about the ropes, then return and endeavour to obtain it; if again refused, he would roll for some time like an angry child upon the deck, uttering the most piercing screams, and then suddenly starting up, rush furiously over the sides of the ship and disappear. On first witnessing this act, we thought that he had thrown himself into the sea; but on searching, found him concealed under the chains."

There is every reason to believe, from the well-known character of the narrator, that this account is as true as it is graphic; but still it throws little light upon the character of the animal in a state of nature. Dr. Abel does not say how he obtained this specimen, at what age it was caught, or what training it underwent before it came into his possession; though, from its conduct in Java, it is quite clear that it must have been a tamed animal, and not "a wild man of the woods" when there; for all the accounts, (scanty as they are) represent the wild animal as not courting the society of mankind, but hiding himself from them in the woods, with far more solicitude than the monkey race. An account of another one, inserted by the same observer in the fifteenth volume of the Asiatic Researches, throws a little light upon the native character of the animal; but it is only a little, inasmuch as it shows only the efforts of the orang-utan to escape from those who were pursuing him to the death. This specimen was of large size, at least seven feet in height, and when first observed he appeared to be fatigued with a journey of some distance, as his legs were covered with mud up to the knees; and he had taken to a solitary tree in order to rest himself. The place where he was observed was on the north coast of Sumatra, out of the thick forest, and with only a few clumps and straggling trees. As the boat's-crew approached him, he seemed apprehensive of danger and aware that the single tree did not afford him an adequate means of safety; so he descended and made for a clump of trees which was at some distance. On the ground his motion was slow and wriggling, and apparently performed with much effort. He had always now and then to steady it by bringing his hands to the assistance of his feet; and he would even deviate a little from the straight course, in order to lay hold of a tall bush or branch, to enable him to swing himself forward; and it is probable that had he found a sufficient succession of these, he would have been able to elude his pursuers by speed; but on the bare places where there was nothing that he could grasp, he made comparatively but little way, and seemed to be out of his element. The rest of the adventure will, however, tell better in Dr. Abel's own words:—

"On being driven to a small clump, he gained, by one spring, a very lofty branch, and bounded from one branch to another with the swiftness of a common monkey, his progress being as rapid as that of a swift horse. After receiving five balls, his exertions relaxed, and reclining overpowered against a branch he vomited a quantity of blood. The ammunition of the hunters being by this time exhausted, they were obliged to fell the tree in order to obtain him; but what was their surprise to see him, as the tree was falling, effect his retreat to another, with seemingly undiminished vigour! In fact, they were obliged to cut down all the trees before they could force him to combat his enemies on the ground; and when finally overpowered by numbers and nearly in a dying state, he seized a spear made of a supple wood, which would have withstood the strength of the stoutest man, and broke it like a reed. It was stated by those who aided in his death, that the human-like expression of his countenance, and his piteous manner of placing his hands over his wounds, distressed their feelings so as almost to make them question the nature of the act they were committing. He was seven feet high, with a broad expanded chest and narrow waist. His chin was fringed with a beard that curled neatly on each side, and formed an ornamental rather than a frightful appendage to his visage. His arms were long even in proportion to his height; but his legs were much shorter. Upon the whole, he was a wonderful beast to behold, and there was more about him to excite amazement than fear. His hair was smooth and glossy, and his whole appearance showed him to be in the full vigour of youth and strength."

In all this, there is still not the slightest relation to human action or resource. When the animal found that he was pursued, he did what all animals, whose nature it is not to stand and face their enemies, do upon like occasions,—he sought that place where he could use his powers to the greatest advantage; and thus he took to the clump, upon an instinct exactly similar to that which makes the chased badger seek his "earth." As to the "piteous cries," uttered by those animals when wounded, they are no proof of reason, or of "intellectual acquirements," as is sometimes most absurdly said. Of all our domestic mammalia, the pig complains the most loudly and piteously, even when but slightly annoyed, and yet we never think of boasting of the "intellectual acquirements" of the pig; and when we apply metaphorically, as is sometimes coarsely done, to a human being the epithet "piggish," or "pig-headed" we certainly do not thereby mean to imply a more than ordinary share of "intellectual acquirements." Yet in his internal organisation, which is really most important in a physiological point of view, the pig resembles man more than any other domestic mammalia do. The pointing to the wounds, is a natural, and almost a necessary act of all handed animals, because they use these organs, as well in endeavouring to rid themselves of every bodily uneasiness and annoyance, as in making way among the branches, seizing their food, and holding it while they eat it. We have as piteous accounts of the apparent reproach of those who wounded them, by monkeys, and monkeys formed very unlike men, and with goodly swinging tails, as that which Dr. Abel relates of the wounded orang-utan. Therefore, in the whole conduct of the animal there does not appear to be even the slightest approach to human action; and consequently we are to regard the whole of the alleged mental acquirements, as gratuitous fancies, founded on the mere fact of the slight structural resemblance. When we apply analysis to that, we find, as has been already mentioned, that the ape is incapable of in any way taking man's place, and man just as incapable of taking the ape's place. The ape is a climbing animal, fitted for residing in thick forests, and collecting wild fruits as his food; and for these purposes his structure is probably the best that can be imagined. His hands can grasp powerfully, and by means of them he can either pull himself up, or, grasping with his hinder paws, he can pull down that which he wishes. He is also said sometimes to use a stick or even two sticks to help him on his way, when he is forced to walk for any considerable distance on his ill adapted feet. But there, or nearly there, the functions of his hands stop; and there is at least no account of his holding a cocoa-nut upon a stone with one hand, and breaking the shell by battering it with another stone held in the other, which is almost the first act of the very rudest savage in those places where cocoa-nuts grow. As is the case with all other animals, his organs of mastication are fitted for the division of his food into swallowable portions; so that, when he has to crack a hard shell, he does it by means of the large and powerful canine teeth with which he is furnished. This, rather than a means either of attack or defence, appears to be the use of those formidable teeth in the apes; and, indeed, feeding seems to be the grand use of all the furnishing of the mouths of animals in what manner soever they are furnished.

The two species which have been mentioned are probably the only true apes, at least they are the only known ones that have neither tails nor callosities on the buttocks. The remainder of the genus *pithecus*, are tail-less; but they have the callosities in a greater or less state of developement. They are sometimes styled *gibbons*.

The SIAMANG (*P. syndactylus.*) This species is known only as an inhabitant of Sumatra, though the probability is that it exists also in the neighbouring islands. It has not been long known to Europeans. It was first observed in the forests of Sumatra, by the late sir Stamford Raffles (who set a most noble example to governors of colonies where the natural history is little known,) and the two French naturalists

P. syndactylus.

Duvaucelle and Diard. The only account, or at least the most satisfactory one, which we have of the manners of the animal in its native forests, is in a letter from the former of these two naturalists to M. F. Cuvier. After mentioning that the Siamangs are very common in the Sumatran forests, that they are often tamed by the natives, and that he had consequently many opportunities of observing the animal both in its wild state and in confinement;—M. Duvaucelle proceeds:—"The siamangs generally assemble in numerous troops, conducted, it is said, by a chief, whom the Malays believe to be invulnerable, probably because he is more agile, powerful, and difficult to obtain than the rest. Thus united, they salute the rising and the setting sun with the most terrific cries, which may be heard at the distance of many miles, and which, when near, stun when they do not frighten. This is the morning call of the mountain Malays, but to the inhabitants of the town, who are unaccustomed to it, it is a most insupportable annoyance. By way of compensation, they keep a profound silence during the day, unless when interrupted in their repose or their sleep. These animals are slow and heavy in their gait; they want confidence when they climb, and agility when they leap, so that they may be easily caught, when they can be surprised. But nature, in depriving them of the means of readily escaping danger, has endowed them with a vigilance which rarely fails them; and if they hear a noise which is unknown to them, even at the distance of a mile, fright seizes them, and they immediately take flight. When surprised on the ground, however, they may be captured without resistance, either overwhelmed with fear, or conscious of their weakness and the impossibility of escaping. At first, indeed, they endeavour to avoid their pursuers by flight, and it is then that their mal-address in this exercise becomes most apparent. Their body, too tall and heavy for their short and slender thighs, inclines forward, and availing themselves of their long arms as crutches, they thus advance by jerks, which resemble the hobbling of a lame man whom fear compels to make an extraordinary effort.

"However numerous the troop may be, if one is wounded it is immediately abandoned by the rest, unless, indeed, it happen to be a young one; then the mother, who either carries it or follows close behind, stops and falls with it, and uttering the most frightful cries, precipitates herself upon the common enemy with open mouth and arms extended. But it is manifest that these animals are not made for combat; they neither know how to deal nor to shun a blow. Nor is their maternal affection displayed only in moments of danger: the care which the females bestow upon their offspring is so tender, and even refined, that one would be almost tempted to attribute the sentiment to a rational rather than an intuitive process. It is a curious and interesting spectacle, which a little precaution has sometimes enabled me to witness, to see these females carry their young to the river, wash their faces in spite of their outcries, wipe and dry them, and altogether bestow upon their cleanliness a time and attention that in many cases the children of our own species might well envy. The Malays related a fact to me, which I doubted at first but which I believe to be in a great measure confirmed by my own subsequent observations: it is that the young siamangs, whilst yet too weak to go alone, are always carried by individuals of their own sex, by their fathers if they are males, and by their mothers if females. I have also been assured that these animals frequently become the prey of the tiger from the same species of fascination which serpents are related to exercise over birds, squirrels, and other small animals.

"Servitude, however long, seems to have no effect in modifying the characteristic defects of this ape: his stupidity, his sluggishness, and his awkwardness. It is true that a few days suffice to make him as gentle and contented as he was before wild and distrustful; but, constitutionally timid, he never acquires the familiarity of other apes, and even his submission appears to be rather the result of extreme apathy than of any degree of confidence or affection. He is almost equally insensible to good or bad treatment; gratitude and revenge are sentiments equally strange to him. All his senses are dull and imperfect; if he regards an object, it is manifestly without any intention—if he touches it, it is involuntarily. In a word, the siamang exhibits an absence of all intellectual faculty; and if animals were to be classed according to their mental capacities, he would certainly occupy a very inferior station. Most commonly squatted on his hams, with his long arms twined round him, and his head concealed between his legs, a position which he also occupies whilst sleeping, he is seldom roused from his lethargy, nor does he break silence unless at intervals to utter a disagreeable cry, which in sound approaches to that of a turkey-cock, but which appears to be expressive of no sentiment, nor to declare any want, and which in reality expresses nothing: hunger itself is insufficient to excite, or divest him of his natural lethargy; he takes his food with indifference, carries it to his mouth without avidity, and sees himself deprived of it without testifying either surprise or resentment."

Perhaps this statement is, in some of the points, a little coloured; but there is an air of graphic truth about it which leaves no doubt of its being accurate in the main; and, altogether, it is perhaps the best account of any of the genus in a state of nature which has hitherto appeared. The sluggish motions and passive character of these animals no doubt render them much more easily observed than their more energetic congeners; and probably the same circumstances cause them to appear more numerous than they are. Their more social disposition with each other, no doubt, also renders them more easily tamed.

Their appearance accords well with their habits, as described by M. Duvaucelle. None of the genus are handsome; but these are peculiarly clumsy and ungainly. The forehead is low, and partly covered by the hair of the crown, which is reflected forward upon it; and the same long hair descends by the sides of the head, and hides the ears. The eyes are shaded under projecting brows, and they are remarkably close together, a circumstance which never fails in giving a mean and ape-like expression to the human countenance, more especially if it is, as in these animals, accompanied by flatness of the nose, lateral, and rather upward, opening of the nostrils, a long upper lip, and great width of gape in the mouth. The uncouth expression of the face is increased by a greasy pouch or sac, under the lower jaw, bearing a considerable resemblance to that in the orang-utan, but rather larger in proportion to the size of the animal. What other purposes these distendable pouches may serve in the economy of the animals which possess them is not known; but in the siamang they are brought into action when the animal howls. The pouch completely hides the chin, or rather there is no chin to be hidden, as the lower jaw is rounded away from the gape, as in the carnivorous animals, and the gape, which is a mere line when closed, opens backward, nearly the whole length of the jaws. The face is farther deformed by high cheek bones; its colour is black; its texture like that of the naked part of a dog's nose; and it is destitute of hair, except a very few straggling red ones, at the upper and under part. The hair on the body is rather long, thick and close, and generally of a black colour. The body is clumsy; the hind legs, out of proportion, small; and the fore ones, though long, are ill put together. One peculiarity of the hinder paws is the adhesion of the first and second fingers, as far as the last joint, or that which bears the nail. It is on this account that it has received the specific name of *syndactylus*, which means, one toe "with," that is, "united with" another. The siamang is inferior in size to the orang-utan; but it is the largest of the gibbons.

The Wouwou, or nimble gibbon (*P. agilis*), is a smaller but far more active species. It inhabits the same forests, but is much less frequently seen. The height of the full-grown male does not exceed two feet eight; and the female is shorter. The arms are long, easily reaching the ground when the animal stands erect. The fingers on the fore-feet are long and clean made, but the thumbs are very short. The thumbs on the hind feet are longer in proportion, and act more directly in opposition to the fingers, than those of any other of the genus. From the structure of the extremities, and the lightness of its body, as well as of the ready and willing use to which it appears to put its powers upon all occasions, the wouwou well deserves the trivial name of *agilis;* for it skips up the trees, and from one tree to another, more like a winged creature than one which depends solely upon grasping. The following figure will give some idea of its climbing attitude:

The Wouwou.

But though this animal is so fleet in its motions, it is by no means handsome in proportion. It has scarcely any forehead, except a projecting ridge, which overshadows and enfonces the eyes. These organs are closer together than even those of the siamang; and though its nose is not quite so flat as the nose of that animal, the nostrils, which are oblique lateral slits, give the termination of it a deformed and mutilated appearance. The face of the male is bluish black, and that of the female has a tinge of brown. The male has long white whiskers, which conceal the ears, meet in a narrow band over the eyes, and give the head a wigged appearance. The female is without these appendages. The covering approaches more nearly to the texture of fur than that of any of the apes that have been hitherto noticed; and the colours are more variable, not only on different parts of the same animal, but at different ages, and in the different sexes. The young are all over straw colour. The adults are generally dark brown on the head and the under part, and very dark on the backs of the hands; but the neck and shoulders are lighter, and the colour passes into dull whitish on the loins and hips.

This species is not so social as the siamang, being found only solitary or in pairs; and from the rapidity of its motions it very speedily gets out of sight. Few animals gain the top of a tree with more celerity; and it appears to make use of the elastic branches in giving effect to its leaps, as, by the help of these, after it has once brought them into proper swing, and itself into proper balance, it can contrive to project itself to the distance of forty feet, and seize the branches after its spring with the most unerring certainty. M. Duvaucelle, to whom we are indebted for almost all that we know respecting it, does not seem disposed to give it much credit for "intellect;" but, as even he seems to ground his opinions of this matter upon the form of the skull rather than the displayed sagacity of the animal, his opinion is, of course, mingled with a portion of that prejudice which some consider inseparable from the whole doctrines of phrenology. It appears that this animal is not difficult to tame; and though, like all apes, it is perfectly useless in a domesticated state, it is playful and active. We omitted to mention, in its proper place, that it is without the pouch or sac on the under jaw, which gives so goitered an appearance to the orang-utan and the siamang; but the absence of that unseemly appendage does not appear to prevent it from crying as lustily in proportion to its size as either of those animals.

The Ounko (*P. Rafflesii*), is another species, the knowledge of which we owe to the same observers. It is more rare than even the wouwou, or if not, it is at all events more rarely seen; and M. Duvancelle remained among its haunts, and even crossed the woods in all directions, for fifteen months, without being aware of its existence. In its form and manners it has a considerable resemblance to the wouwou; but it is smaller, and the colour inclines more to black. There is no pouch, or dilatable skin, under the chin of the ounko; and otherwise its external characters are a sort of combination of those of the siamang and the wouwou. The colour approaches that of the siamang, except on the loins and some other parts, where the points of the hairs are glossed with brown. The texture of its covering more resembles that of the wouwou; but the hair is more produced on the back and shoulders, forming a sort of mane. The male has the same white whiskers as the wouwou, and, as in that animal, they unite and form a white band over the eyes. The female is without these appendages, and has only two slight brownish marks over the eyes. It is smaller than the male, and according to the accounts it has the first and second toes of the hind feet united as in the siamang, while those of the male are free. This species has, however, been so rarely seen that its history is far from perfect.

The Black Gibbon (*P. lar.*). The darkness of its general covering, the white round the face, and the demure look of this animal, give it a more solemn appearance than most of the other apes. It is about the same size with the ounko, and has sometimes been confounded with that animal; but in its internal structure it has a rib fewer on each side, and externally the paws and fingers are grey, while those in the ounko are black. The manners of the two species, from what is known of them, appear to be similar. They inhabit the close forests; and as they are lighter they resort more to the extreme branches than the larger apes, and make considerable use of the more flexible ones in swinging themselves from tree to tree. Though gloomy in its looks, the black gibbon is said to be gentle in its manners, and slow in its motions, as compared with some of its congeners. None of the toes on its hind feet are united.

The Ash-coloured Gibbon (*P. leuciscus*) is a much more energetic animal than the former, and bears some resemblance to the wouwou, which name is sometimes given to it by the Malays, no doubt in imitation of its cry. Its general colour is ashen grey, lighter round the face, and with the ears at top of the head, and all the feet dark brown. The callosities and buttocks are much larger than in any other of the gibbons; and the walk along the ground is said to be generally erect. In that posture of the spine, it is described as being capable of using all the four feet with equal effect, the fore ones being considerably longer in proportion than in any other of the genus. It is described as being a very adroit climber, and as showing great address while balancing itself on the tops of bamboos and other tall and flexible stems. In maintaining its balance in such situations, it uses its long arms something in the same manner as a rope-walker uses his pole; but still the action is very different, for the rope-walker balances himself on points of support, without any thing that can be called grasping, whereas the ash-coloured gibbon merely balances itself upon the powerful grasp of its hind feet. Those feet have all the toes true as in the black gibbon, and therefore they suit better for grasping small stems and twigs than those which have them partially united.

Such are at least the principal species of the ape genus, so far as at present known; but it is highly probable that more intimate research in the Oriental isles, and the analogous portion of the Malay peninsula, may farther increase the numbers. There is no well-authenticated account of their appearance in any other part of the world than the south-east of Asia, where, as has been hinted, the weather is pretty nearly uniform all the year round, the soil uniformly fertile, the forests thick and tangled, and the trees abounding in fruit, some species of which is almost always in season. Those forests are close and luxuriant; but they are not so tangled and interlaced with creeping plants as the forests of the humid parts of tropical America. They seem to differ also from the forests of tropical Africa, in which, with the exception of the baobab and a few others, which grow straggling and generally alone on the rich plains and bottoms, the trees are thin topped, and do not form a canopy. Few of them, in proportion, too, bear fruit fit even for ape's food; and therefore they are not proper localities for animals whose march is almost exclusively among the branches. They suit better with the baboons, which can walk upon all fours with considerable rapidity.

APEIBA (Marcgraav). A genus of four species of ornamental timber trees from South America. Linnæan class and order, *Polyandria Monogynia.* Natural order, *Tiliaceæ.* Generic characters: calyx five-cleft, coloured within, deciduous; corolla, petals five, somewhat clawed smaller than the calyx; stamens very short; anthers long egg-shaped, outside swollen, with two leafy lobes at top, exterior ones sterile; style elongated, dilated at the top into a funnel-shaped toothed stigma; capsule round, depressed, leathery, many celled; seed small, roundish, and nestling in the pulp. Some botanists describe this genus under *Aubletia.*

APETALOUS PLANTS are (otherwise called monochlamideous) all such as bear flowers having a calyx but no corolla. Of these there are twenty-seven orders, containing two hundred and fifty-six genera, and two thousand six hundred and twenty-eight species. Young botanists are often puzzled in applying the proper terms to the parts of apetalous flowers; but they may be guided by this rule, viz., whenever there appears only one floral envelope or outer expansion round the central members of the flower, that envelope is to be considered as the calyx, whatever may be its form or colour. Such a member is called perianthium (round the flower), and is, in this sub-class of the Jussienan arrangement, generally simple. As instances of this mode of florescence the mezerion and marvel of Peru have the calyx highly coloured, and bearing the semblance of a corolla, though, according to the above rule, these coloured parts are calyces and not corollæ.

This circumstance shows that the corolla is not an essential part of a flower, nor when present, is its use or function in the economy of the plant very apparent. It is generally the most delicate and fugitive member of the flower; and neither from texture or position can it afford much protection to the more essential and reproductive organs. Still, however ignorant we may be of the real use of the corolla, we may rest assured that it answers some important purpose; its delicacy of texture, and powerfully reflective surface of every ray of light, is not merely ornamental: they are at least attractive to the honey-seeking insect, which

> "———transports the fertilising meal
> From flower to flower—
> Then act in nature's office, bring to pass
> The glad espousals, and ensure the crop."—THOMSON

In this view the high colours of the corolla are of the greatest importance even more than we are aware of; for who can estimate the good performed by the unconscious bee flitting from flower to flower, who can fully appreciate how much man is beholden to their interference in perfecting the fruits of the earth?

Other circumstances deserve remark: where colour is wanting in the flowers we often see it bestowed on the foliage: example, *amarantus tricolor*; and where flowers are inconspicuous they are often highly odorous: instance, mignonette.

APHANIPTERA (Kirby). *Aptera* (Linnæus Lamarck). *Rhyngota* (Fabricius). *Suctoria* (Latreille). An order of insects including the common bed-flea and the fleas of various animals. This is an osculant order, and is distinguished from the other *Aptera* of Linnæus in undergoing a regular metamorphosis. The larva is vermiform, the pupa incomplete, and inclosed in a coccoon. Probably the common flea and chigoe would form distinct genera; there are many species belonging both to birds and quadrupeds; amongst the latter the squirrel, the mole, and soft haired animals appear subject to them.

Besides their metamorphosis, they are distinguished from the *Aptera* by the number of segments into which their body is divided, and by their pentamerous tarsi. The following are the characters as given by Messrs. Kirby and Spence:—

Metamorphosis incomplete.

Body apterous, compressed.

Mouth rostrulate, the labium and palpi being elongated.

Tarsi pentamerous, or five-jointed.

Under the head of FLEA, we shall give its popular and natural history; and under the head PULEX, we shall give all the genera as described by the latest authors.

APHANOCHILUS (Bentham). An herbaceous perennial, introduced from Nepaul, belonging to the order *Labiatæ.* It is the same plant called mentha blanda by Mr. Lindley.

APHELEXIS (D. Don). A genus of ornamental green-house under-shrubs, introduced from the Cape of Good Hope. Linnæan class and order, *Syngenesia superflua.* Natural order, *Compositæ.* There are four species, and they were formerly supposed to be either elichrysums or xeranthimums by other botanists.

APHIDÆ (Leach). An extensive family of insects of the order *Homoptera,* and embracing the genus *Aphis* (Linnæus). This family has the tarsi two-jointed, the first joint very short: rostrum in both sexes; antennæ with six, seven, or eight joints; females generally apterous; tarsi with the last joint vesiculous; upper wings in the males larger than the lower; head transverse.

This family contains the genus *Aphis*, of Linnæus. Antennæ setaceous or filiform, seven jointed; elytra larger than the wings, elongate, triangulate; abdomen towards the apex generally tuberculate or horned; eyes entire. Several other genera have recently been added to the family.

The animals of this genus are very numerous, and destructive at times to almost every species of plant. There is a difficulty in preserving the species from their being minute and soft, but we should recommend the entomologist who would wish to make himself acquainted with the numerous species already described to attach to each specimen the name of the plant on which it was found. The most familiar name by which they are generally known in this country, is *plant lice*, the French call them *pucerons*. The minute animals of this genus live entirely on vegetables, and the loftiest tree is as liable to their attacks as the most humble plant. Their numbers are often incalculably great. They prefer the young shoots, on account of their tenderness, and frequently insinuate themselves into the very hearts of the plants, doing irreparable mischief even before they are discovered. But for the most part they beset the foliage, and are always found on the under side of the leaf. This they prefer, not only on account of its being the most tender, but because it affords them protection from the weather, and from various injuries to which they would be otherwise exposed. Sometimes, though very rarely, the root is the object of their choice, and the roots of lettuces have been observed so thickly beset with one of the species that the whole crop has been rendered sickly and of little value. They are rarely, except one species (*aphis salicis*, which is larger and much stronger than the others), to be found on the bark of trees.

These insects are sometimes winged, and sometimes destitute of wings, this variation not depending upon the distinction of sex. In the spring they are viviparous, producing the young alive; and in the autumn they are oviparous, depositing their eggs, like most other insects, in places where they remain secured through the winter till the ensuing spring, when they are hatched. The aphides afford also another surprising deviation from the general laws of nature; one impregnation of the female is sufficient for nine generations. Their beak, the sheath of which is composed of five joints, is inflected. The antennæ are tapering, and longer than the thorax. They have either four wings, or are entirely destitute of them. At the extremity of the abdomen there are two obtuse erect horns; and the tail is sometimes terminated by a small style.

The larvæ and perfect insects are said to have so little difference in external appearance that they cannot be distinguished from each other, except by size.

Aphis Rosæ.—This insect, which is well known by the name of rose louse, is generally of a green colour; with the tip of the antennæ and horns black. The tail is pointed and without a style. Towards the beginning of February, if the weather be sufficiently warm to make the buds of the rose tree swell and appear green, this species of aphis will be found on them in considerable abundance. They are produced from small black oval eggs, which were deposited in autumn on the last year's shoots. If after their appearance the weather become cold, almost the whole of them suffer, and the trees are, for that year, in a great measure freed from them.

Those that withstand the severity of the weather, seldom arrive at their full growth before April, when, after twice casting their skins, they usually begin to breed. It then appears that they are *all females*, and each of them produces a very numerous progeny, and that without any intercourse with a male insect. These, though themselves produced from eggs, are viviparous. Their young, when they first come from the parent insects, are each enveloped in a thin membrane that has the appearance of an oval egg. This apparent egg adheres by one extremity to the mother, while the young aphis proceeding from it extends the other, by this means gradually drawing the ruptured membrane over the head and body to the hind feet. During the operation, and for some time afterwards, the forepart of the head adheres, by the viscous matter about it, to the tail of the parent. Thus suspended, it soon entirely frees itself from its former envelopement; and when its limbs become a little strengthened, it is set down on some tender shoot, and there left to provide for itself.

In the spring months there appear but these two generations of the aphis: the warmth of summer, however, produces no less than five. One of these comes forth in May, and the months of June and July supply each two more. The insects of the May breed cast their skins twice, and the others three or four times, according to the warmth of the season. When the heat has been sufficiently great, and the food in tolerable plenty, the first change has been observed to take place in about ten days after their production.

Early in June some of the third generation, which were produced about the middle of May, after casting their last covering, exhibit four erect wings much longer than their bodies. The possession of the wings seems to depend not on sexual distinction, nor even on the original structure of the insects, so much as on the quantity and quality of the nourishment with which they are supplied. Few of those on succulent shoots have wings, while those of the same generation on the less tender branches are most of them winged. Some time before they come to their full growth, it is easy to discern which of them will have wings, from a remarkable fulness of the breast. When the last covering is thrown off the wings, which were before folded in a very narrow compass, gradually extend in a most beautiful manner to their proper size and dimensions. All the following breeds are winged. In the autumn, the eighth, ninth, and tenth generations are produced; two in August, and the last about the middle of September. The two first resemble the summer breeds, but the third differs very greatly from all the rest. Though all the aphides which have hitherto appeared have been females, in this tenth generation several *male* insects are found. The females have at first the appearance of the summer insects, but in a few days their colour changes from green to yellow, and gradually, before their full growth, to orange. These yellow females are destitute of wings. The males, when they first appear, are of a reddish-brown, but have afterwards, when they begin to thicken about the breast, a dark line along the middle of the back. They come to their full growth in about three weeks, and then, casting their last skin, appear in every part, except the wings, of a bright yellow. They soon, however, become dark brown; the wings become transparent, and at length are in appearance not unlike very fine black gauze. The females soon begin to deposit their eggs, which, if possible, is always done near the buds of the branches, that the future young may be the more easily supplied with nourishment. Some of them continue laying their eggs till the beginning of November: these are oval, and when first protruded are green, but they soon become perfectly black. They adhere to the branches on which they are deposited, by the viscous matter that at first surrounds them. These eggs remain through the winter till the ensuing spring before they are hatched.

If the aphides had not many enemies, their increase in summer would be so great as, by wounding and exhausting the tender shoots of the trees, sometimes to suppress their vegetation. Among their enemies, one of the principal is a small black species of ichneumon fly, which darts its pointed tail into the bodies of the aphides, and at the same time deposits in each an egg. This egg afterwards produces a grub, which feeds within the body of the insect till it has acquired its full growth, when it undergoes its change, and entirely destroys its living nidus.

After a mild spring, most of the species of aphis become so numerous as to do considerable injury to the trees on which they are found. The best mode of remedying this evil is to lop off the infected shoots before the insects are greatly multiplied, repeating the same operation before the time that the eggs are deposited. By the first pruning a very numerous present increase will be prevented; and by the second, the following year's supply may in a great measure be cut off.

Aphis Humuli.—As illustrative of the vast importance of this insect to the British treasury, the following observations by Rusticus may give our readers some idea. "In the year 1802, on the 14th of May, the old hop duty was laid at 100,000*l.*; the fly, however, appearing pretty plentifully towards the end of the month it sunk to 80,000*l.*; the fly increased, and, by the end of June, the duty had gone down to 60,000*l.*, by the end of July to 30,000*l.*, by the end of August to 22,000*l.*, and by the end of December to 14,000*l.*; the duty actually paid this year was 15,463*l.* 10*s.* 5*d.* In 1825, the duty commenced at 130,000*l.*, but owing to the excessive increase of the fly, had in July fallen to 16,000*l.*; at the beginning of September it rose to 29,000*l.*, but towards the end fell again to 22,000*l.*: the amount paid was 24,317*l.* 0*s.* 11*d.* In the following year the summer was remarkably dry and hot; we could hardly sleep of nights with the sheets on; the thermometer for several nights continued above 70° all the night through: the crop of hops was immense, scarcely a fly was to be found, and the betted duty, which began in May at 120,000*l.*, rose to 265,000*l.*; the old duty actually paid was 262,331*l.* 0*s.* 9*d.*; the gross duty, 468,401*l.* 16*s.* 1*d.*, being the largest amount ever known. From this it will appear that, in duty alone, a little insignificant-looking fly has a controul over 450,000*l.* annual income to the British Treasury; and supposing the hop-grounds of England capable of paying this duty annually, which they certainly are, it is very manifest that in 1825 these creatures were the means of robbing the treasury of 426,000*l.*; this seems a large sum, but it is not one-twentieth part of the sums gained and lost by dealers during the two years in question."

APHODIIDÆ. A family of *Coleopterous* insects proposed by Mr. Macay in the Horæ Entomologicæ, for the reception of two genera, *Aphodius* and *Psammodius*, separated from the Linnæan genus, *Scarabæus*, and forming part of the modern group termed *Lamellicorns.* These insects are amongst the smallest of the *Scarabæi* of Linnæus. Their bodies are of an elongated form, their legs inserted at equal distances from each other; they are furnished with a visible scutellum, and their palpi are smooth. They subsist for the most part upon the excrements of various animals, over which they may be constantly observed flying, and in which the sluggish larvæ reside. Of the genus *Aphodius* of Illiger (distinguished by the cylindric palpi and unarmed lower jaws) about sixty species have been observed in Great Britain; of which the *Scarabæus fossor* of Linnæus is the most common; it is about one third of an inch long, of a shining black colour; the shield of the head (clypeus) with three tubercles, the central one being the longest. The other genus, *Psammodius*, of Gyllenhal, evidently approaches some of the *Trogidæ* in its characters; it is distinguished by its thickened palpi and armed lower jaws. The *Scarabæus sulcicollis*, of Fabricius, may be considered as the type. The number of species of this genus is small, and the insects are generally found in sandy situatians, in the neighbourhood of the sea coast.

APHYLLÆ. The second class of the grand division *Cellulares*, containing all those vegetables which have no leaves. It includes the orders *Algæ*, *Lichenes*, and *Fungi*, of which there are 273 genera and 2022 species, many of which will be noticed under their proper names. The accompanying vignette will convey a good idea of plants which form this class.

Aphyllæ.—*Fungi: a*, Phallus indusiatus; *Algæ: b*, Dumontia interrupta; *Lichens: c*, Squamaria Smithii; *d*, Imbricaria cærulescens; *e*, Collema nigrescens; *f*, Imbricaria grisea; *g*, Urceolaria occellata.

APIDÆ (Leach). One of the two families of bees, of far greater extent than the andrenidæ, and, as noticed under the article Apis in the next page, at once distinguished by the length of the terminal parts of the lower organs of the mouth, which form a trunk, folded beneath the head and breast when at rest, but stretched forward when the insect is employed in ravaging the flowers of their nectar. The construction of the mouths of these insects is exceedingly curious, and will be detailed under the article Bee.

From their habits the insects of the family are divisible into two groups; 1st, the solitary, and 2nd, the social bees. In the former the shank of the hind legs of the females is clothed with hairs, whilst in the latter, this portion of the leg is broad and concave, forming a shallow trough for the carrying of pollen. The solitary bees in the recent distributions of Latreille form four sub-families; 1st, the *Andrenoides*, a group of small extent, consisting of the genera, *Systropha*, *Rophites*, and *Panurgus;* 2nd, the *Dasygastres*, or woolly-bellied bees. consisting of the leaf cutters (*Megachile*), upholsterer bees (*Osmia*), some of the mason bees, and others: 3rd, the *Cuculinæ*, or cuckoo-bees, including the genera, *Epeolus*, *Nomada*, *Melecta*, &c.; and 4th, the *Scopulipedes*, or brush-legged bees, including the mason bees, *Anthophora*, and some others. The social bees consist of the genera of humble bees (*Bombus*), hive bees (*Apis*), with several other allied exotic genera. It must be evident that in a work of this kind it will be impossible to enter into the details of the structure and habits of all the various kinds of bees, since volumes would not contain a complete account even of the hive bee alone. We shall, therefore, under the article Bee, give a short notice of the hive bees, and shall detail the economy of the other groups under their respective heads.

APION. A very extensive genus of minute beetles (*Coleoptera*), belonging to the family of the weevils (*Curculionidæ*), established by Herbst, and distinguished by the elegant pear-shaped form, the protruded snout, and the straight antennæ of the species. About ninety species have been found in England. They subsist upon vegetable productions, occasionally doing much mischief. The yellow-thighed apion (*A. flavifemoratum*), feeding upon the seeds of the purple clover and the yellow-footed apion (*A. flavipes*), upon the Dutch or white clover, the larva feeding upon the heads. Mr. Kirby has made an interesting observation respecting an insect of this genus, with reference to the supposed uses of the antennæ; whilst examining it under a lens, its antennæ started upon his making a slight but distinct noise, and which it repeated as often as the noise was renewed. This circumstance has been regarded as affording a proof that the antennæ are organs of hearing (Insect Miscell., p. 107); but from the extreme sensibility of these portions of the body, we should rather be inclined to refer their starting to the operation upon them of the vibrations in the atmosphere, caused by the production of such noise. One of the handsomest, and at the same time commonest species of the genus is the *Curculio frumentarius* of Linnæus; it is about one-sixth of an inch long, of a bright red colour, and is generally found upon the dock.

APIOS (Borelli). A single genus of tuberous-rooted plants, native of North America, belonging to the Linnæan class and order, *Diadelphia decandria*. Natural order, *Leguminosæ*. Generic character: calyx bell-shaped, limb oblique, three teeth short, the fourth or inferior one elongated; keel bent like a sickle, standards bent back at the top; tube notched and fixed below the germen; pod leathery, two-celled, the cells interrupted. This plant is closely allied to *glycine* or *wisteria*.

APIS—the bee. In the Linnæan system of insects this name was employed to designate all those hymenopterous insects which have the lower parts of the mouth formed into a trunk, and bent downwards, the antennæ elbowed in the middle, the wings smooth, and body generally hairy. It included, therefore, not only the honey bee, humble bees, mason bees, leaf-cutter bees, carpenter bees, &c., but also a great number of other species, whose habits were and still are unknown. On more minutely examining the characters possessed by some of them, it was found that the trunk was very short, whilst on the others it often attained a very considerable length, being sometimes as long as the whole body; hence, by Reaumur and De Geer, the latter were regarded as the true bees (forming the genus *Apis*, in Mr. Kirby's admirable *Monographia Apum Angliæ*), whilst to the latter they gave the name of pro-abeilles, which are the andrenæ of Fabricius and the melittæ of Mr. Kirby. On reviewing the whole order of hymenopterous insects, however, these two groups still possess characters in common of such importance as to warrant their formation into a separate section, which has been termed Anthophila (lovers of flowers), or Mellifera (gatherers of honey, or rather of pollen); indeed the latter peculiarity is supported by that singularity of structure which distinguishes the group, namely, the large and dilated size of the basal joint of the posterior tarsi. The two groups above noticed constitute the two families of which, in the modern classification, this section mellifera is composed, namely, first, the Andrenidæ (which see *), and second the Apidæ.

APISTES—treacherous, a genus of Acanthopterygeous, or spinous-finned fishes, belonging to Cuvier's second family of the order, or those which have armed cheeks (*joues cuirassées*); they have teeth in the palate, and only one dorsal fin. Their peculiar character is a strong suborbital spine, with which they are very apt to inflict wounds in the hands of those who incautiously touch the sides of their heads. They are fishes of rather small size, and inhabiting chiefly the warmest seas. One subdivision have the body scaly, with large pectoral fins and one free spinous ray; another have the pectoral fins of moderate size and without any free rays; and a third have the body free from scales, and free rays under the pectorals. Some of the species are found on the coast of Australia; but the habits of all of them are very little known.

APLYSIA-LAPLYSIA (Linnæus, Lamarck). A molluscous animal, belonging to the class *Paracephalophora;* order, *Monopleurobranchiata;* and to the family of *Aplysiacea*.

The body of this animal is thick, fleshy, and oval,

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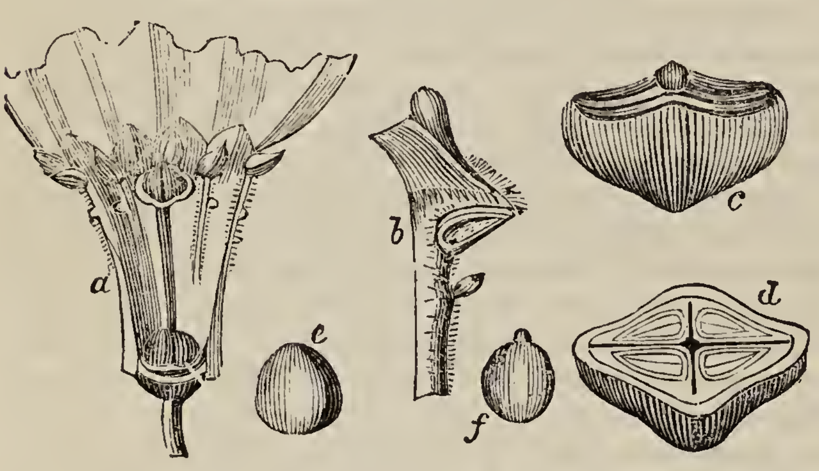
* It has been inadvertently stated in this article, that although the species of Andrenidæ consist only of two kinds of individuals, males and females, yet that they live in societies. Now it is a physiological circumstance of much interest that all social hymenopterous insects are provided with neuters, for the due support of the community. Neuters are accordingly found amongst the ants, the true wasps, the hive bees, and the humble bees. When, therefore, no neuter individuals exist we may be certain that the insects are not social; now this is precisely the case with the burrowing wasps (*Odynerus*), with many of the Apidæ and with the Andrenidæ. It is true that the latter are often found congregated thickly about some sunny bank, or other convenient place, but their sociality is of no higher order than that which exists amongst the inhabitants of the same street in large towns, where one person scarcely knows his next door neighbour.

provided beneath with a rather thin flat foot; on each side there is a natatory appendage; above and posteriorly there is a kind of operculated buckler, internally solidified by a rudiment of shell, more or less calcareous and regular, covering the cavity of the bronchiæ; two pair of slit auriculated tentacula, the one occipital, the other labial, with very small sessile eyes, placed between these two. Lamarck enumerates three species. Gmelin corrected the name of this genus from *Laplysia*, to the present one, which is more correct, the other having probably originated in a typographical error, overlooked by subsequent authors.

APOCYNEÆ. A natural order of dicotyledonous plants allied to the asclepias, a family. It constitutes the hundred and twenty-eight order of the Jussieuan system (Loudon), and comprises upwards of forty genera and a hundred and sixty species. The following are the botanical characters of the family:—Calyx, consisting of five divisions; corolla monopetalous, regular, five-lobed, and contorted; stamens, five, arising from the corolla; anthers, two-celled, opening longitudinally; one or two superior ovaries, and the same number of styles; fruit, a capsule, a drupe, or a berry. The twisted or contorted segments of the corolla, resembling a catherine-wheel, may be looked upon as a characteristic mark of the family, and on this account the term *contortæ* was applied to it by Linnæus.



APOCYNEÆ (*Cerbera thevetia*).—*a*, portion of the corolla opened to show the stamens and pistil; *b*, stamen, with a portion of the corolla; *c*, fruit; *d*, transverse section of the same; *e*, seed; *f*, embryo.

The plants included under the order are trees or shrubs, principally natives of the tropical regions of Asia, Africa, and America. A few of them are hardy, and grow in the colder zones of the earth.

They are acrid, stimulating, and slightly astringent. These properties, when existing in a weak degree, may be turned to useful account; but when concentrated and powerful, they form active and dangerous poisons. The apocyneæ also possesses narcotic qualities. Most of them yield a milky juice, remarkable for its bitterness and acrimony.

This is a very important order, and furnishes many substances which deserve attention, both in a toxicological and medicinal point of view.

Among the poisonous plants included under the apocyneæ, we may particularly notice the *cerbera tanghin* or *tanghinia venenifera*, the poison tanghin, formerly used in Madagascar as an ordeal for the conviction of criminals. The kernel of the fruit of this plant, although not much larger than an almond, is sufficient to destroy upwards of twenty individuals. In Madagascar, portions of the poisonous kernel used to be administered by persons denominated *skids* (who united the offices of priests and physicians) to those who denied the crime of which they were accused. The poison was considered an unerring means of revealing guilt and clearing innocence. It began generally to take effect within half an hour after its administration. Particular notice was taken of the mode in which the wretched victims fell, whether on their face, back, or side, inasmuch as different shades of guilt were supposed to be indicated by these positions. Convulsions came on, accompanied with efforts to vomit. If vomiting took place early, the person generally recovered; if not, insensibility ensued, and death speedily followed. Those who recovered were looked upon as beings of a superior order, and as the peculiar favourites of heaven. It was with great difficulty that the chieftains of Madagascar were persuaded to abolish this ordeal, which had been in existence among them from time immemorial, and was considered of such importance in the detection and punishment of guilt.

Under a subdivision of the apocyneæ, to which the name of *strychneæ* has been applied, we find the genus *strychnos*, some of the species of which have long been noted for their active poisonous properties. The *nux vomica* which has long been used as a poison for rats, is the seed of one of the species of this genus, viz., the *strychnos nux vomica*, poison-nut, or rat's-bane. From this species, as well as the *strychnos sancti Ignatii*, *colubrina*, and *ticuté*, a peculiar crystalline, alkaline substance, called strychnia, or strychnine, is procured by chemical means. It is one of the most destructive and violent poisons which has been hitherto discovered. A dog has been killed in two minutes by injecting into its chest a sixth of a grain of strychnia dissolved in spirit; and a wild boar has been killed in the same way with a third of a grain, in ten minutes. Half a grain introduced into a wound, Dr. Christison says, would kill a man in less than a quarter of an hour. Strychnia has a peculiar action on the animal frame: it produces tremblings, stiffness, and startings of the limbs, lock-jaw, general rigidity, and difficulty of breathing. If the dose is very small these symptoms pass off, or may be removed by the use of brandy and other stimulants; but if the dose is large, the spasms become violent and succeed each other rapidly, and death soon takes place from suffocation, which is induced by the spasms affecting the muscles of respiration. The brain is not affected, and the mental faculties remain unimpaired. From these symptoms it is concluded that strychnia acts on the spinal marrow alone. Notwithstanding its powerful effects, this substance has been used with considerable success in various diseases, more especially palsy, dysentery, and cholera.

From the *Strychnos ticuté* there is procured a poisonous juice, well known under the name of upas. This famous Javanese poison owes its virulence to the presence of strychnia, and is employed to cover the ends of arrows and other instruments of warfare. Concerning the upas-tree, or poison-tree of Java, many marvellous stories were formerly propagated. It was stated that no plant could live within the distance of a stone-cast round it—that if birds happened to alight on its branches they instantly dropped down dead, and that in order to procure the poisonous juice without endangering life, it was necessary to have the whole body covered with a strong cotton cloth. The recent researches of botanists have proved these accounts to be fabulous and exaggerated. The upas-tree is found in India, growing along with many pleasant aromatic plants, such as the pepper, the clove, and the nutmeg ; and we thus find the same heats of a vertical sun giving energy to the juices of the most fatal as well as the most salubrious species.

The bark of the *Strychnos colubrina* has been used as an antidote against the bite of the snake called cobra de capella (*Coluber major*). There are several species of strychnos, such as the *potatorum*, *brachiata*, and *pseudoquina*, which do not possess poisonous properties. The bark of the last-mentioned species is employed in Brazil, under the name of quina do campo, as a substitute for Peruvian bark, in the cure of intermittent fever.

The bark of the *Cerbera manghas*, one of the apocyneæ, is purgative. The root of the *Ophioxylon* possesses similar properties ; it is used in India under the name of snake-root, as an antidote to the bites of serpents. The root of the *Neicum odoratum* is poisonous, while its sweet-scented leaves are employed externally to dispel inflammatory swellings. The leaves of the periwinkle or hinca are astringent, and have been used successfully in tanning. The *Wrightia tinctoria* yields a beautiful blue dye.

Some of the apocyneæ possesses nutritive qualities. Among these may be noticed the cream-fruit of Sierra Leone, and the *Tabernæmontana utilis*, the hya-hya, or milk-tree of Demerara. The milk-like fluid which is obtained in great abundance from the latter plant, has been used as an article of diet. It is thicker than cow's milk, is destitute of all acrimony, and resembles in appearance the vegetable milk of the palo de vaca, or cow-tree of the Caraccas. The fruit of the *Carissa edulis* is eaten in Nubia. The young shoots of the *Apocynum Indicum* are also employed dietetically, as it is said the pulp surrounding the seeds of most of the apocyneæ, whether poisonous or not, is innocuous, and may be eaten as food.

Caoutchouc, or Indian-rubber, is procured from the *Urceola elastica*, a climbing plant of Sumatra, as well as from various other plants belonging to this family. The milky juice of these plants is smeared over moulds of clay made in the form of bottles, and is afterwards dried in the smoke. After the first layer is dried another is added, until the necessary thickness is obtained. In this way bottles of Indian-rubber are prepared. The black colour of the caoutchouc is owing to the smoke in which it is dried.

There are many other plants included under this interesting order, which possess properties rendering them useful in a medical and economical point of view ; but those alluded to are sufficient to show the general properties of the order, and the important place which it holds in the vegetable world.

APOGON—beardless. A genus of spinous-finned fishes belonging to the perch family, and so much resembling the mullets as sometimes to be called the beardless mullet, and at other times the king of the mullets. They are fishes of small size, and remarkable for the brightness of their red colour. They have two dorsal fins, and the ventral fins are situated immediately under the pectorals. Their bodies are short and covered with large scales, which are understood to be shed and reproduced once a year, or even oftener. They are without the beard or cirrhi, which fringe the under lip in the true mullets ; and it is on this circumstance that the generic name apogon is founded.

APONOGETON (Thunberg). A family of four species, stove and greenhouse perennial aquatics, natives of India and the Cape of Good Hope. Linnæan class and order, *Hexandria Trigynia ;* natural order, *Fluviales.* Generic character : flowers on spikes arranged on one side, bracteas distinctly coloured ; calyx none ; corolla none ; stamens inserted on the common receptacle ; filaments dilated at the base, awl-shaped ; anthers roundish ; stigmas three or four, awl-shaped, turned back ; capsule one-celled, three-seeded.

APPLE. Although this is a general name for many different kinds of fruit, it is more especially applied to the common orchard-tree, called by botanists *Pyrus malus.* Of the pyrus, or pear family, there are forty-six distinct species ; and of two of these, viz., *Pyrus communis*, the pear ; and *Pyrus malus*, the apple ; there are innumerable varieties. Linnæan class and order, *Icosandria Di Pentagynia ;* natural order, *Rosaceæ.* Generic character : calyx five-cleft, persisting ; corolla five petaled, petals rounded ; stamens inserted on a raised ring on the throat of the calyx ; filaments awl-shaped ; anthers two-celled ; styles less than five ; apple five-celled ; each cell two-seeded ; partitions of the cells cartilaginous, as are also the coats of the seeds.

The common apple is decidedly the most useful fruit in cultivation. Its characteristics of hardiness of the tree, beauty of its flowers, and wholesomeness of its fruit, whether the pulp be used as food, or its juice as drink ; whether immediately from the tree, or from the fruit-room six months after gathering, the apple is one of the choicest gifts of nature.

Notwithstanding the great variety of our orchard apples, it is more than probable that the wild crab of our woods and hedges is the common ancestor. The first accidental variation of the crab no doubt occurred in the woods, as we see is the case at the present day. Such would naturally attract the notice of the planter. The stranger would be transplanted to the garden, where its peculiar properties would be in time imperceptably diffused among congenial neighbours. Hence a collection of *wildings* would be brought together ; and from among them a higher grade would originate, and henceforward take the name of apple. But as these new favourites could not be propagated by their seeds (except by accident, as they themselves had been), the arts of layering, grafting, &c., were had recourse to, for the purpose of perpetuating the kinds. By these means the new varieties were continued by cultivators ; and it appears that from the great number of excellent sorts possessed by our forefathers, as good sorts were obtained by accident in those days, as we now procure from the best practice assisted by science. The old golden pippin, golden russet, and rennette, nonpareil, and several others, still rank as high in public estimation as any of the new sorts lately brought into notice by the ingenious device of artificial impregnation.

The method of obtaining new varieties by impregnating the female organs of an inferior sort by the pollen or male dust of a superior kind, is only performed by curious cultivators, either in the cider districts or by nurserymen. The more simple and easy way of raising young trees, is by grafting the desired kinds upon crab-stocks raised from seeds collected in the woods. The seeds or pips are, when fully ripe, taken from the capsules, dried, and kept in dry sand till March, then sowed in rich, well-broken soil, in drills an inch and a half deep. When the seedlings are two inches high, they are thinned, kept free from weeds, and transplanted at the end of the second year into nursery rows, thirty inches apart, and at eighteen-inch distances plant from plant, there to stand till they are fit to receive grafts.

According to the management they receive, or to the suitableness of the soil on which they are grown, stocks may be ready for the graft in the second or third year after being planted out. In the next season after the operation of grafting is performed, it should be determined for what purpose and in what form the young tree is wanted. Apple-trees are required for walls, or espaliers, or for dwarf standards. For all these purposes the graft should be inserted as close to the ground as possible; and this to allow the production of branches below, in order that the trainer may have a choice to give the tree the required form. But for orchard planting tall standards are requisite, in order that the branches may be out of the reach of cattle, or not encumber the surface where under-crops are raised. For this purpose the nursery practice is to choose the leading shoot of the graft, pruning off all laterals, and leading this upright with a clear stem, and only stopping or beheading it when it has risen six feet and a half or seven feet high. At this height the tree is permitted to branch out with three, four, or more arms as the manager thinks best. Obtaining a like length of clear stem is sometimes accomplished in another way; stocks are trained upright, and the graft or bud is afterwards put in at the proper height. This is often done in the case of plums or cherries, where tall stocks can be drawn from the woods in the neighbourhood.

A fresh, loamy, well-trenched soil is most suitable to the apple when planted in an orchard; no pruning is required after the first and second year, and then only to regulate the first branching. In such situation the trees are required to grow to their natural size as soon as possible; and they will, without assistance, assume their specific form. But when introduced into a garden, and where they are compelled to take some unnatural shape, or be cramped in a limited space, no fruit tree requires more attention from the manager than the apple. In its utmost volume it is only a small tree; but when trained to a wall or espalier, or confined to the form of a bush on a narrow border, no tree struggles more to fly away from the artificial form imposed. Hence much pruning is required to keep it symmetrical; and so sure and so long as this struggle continues, few fruit will be seen. And the reason is, the tree is in a constant state of barren excitement. The fructiferous gems inherent in the system require to be moderately developed. In their progress from incipient existence in the bosom of a bud, until they are mature as a visible flower-bud, the process must be slow; otherwise strong flowerless shoots will only be put forth instead of flowers. And these strong shoots producing irregularity, and an appearance of wildness, must be pruned away only to excite a new growth of others of the same kind to come forth. Thus a tree so managed can neither be kept in a neat form or be at all fruitful. What adds to this luxuriance is, that while the head is annually reduced, the roots are annually extending; and instead of these two principal parts being equally balanced (as they always are in a natural state of a tree), they are not so; but, like a basket-maker's willow, the more it is cut the more it grows.

But this state of an apple-tree is not necessarily so: by skilful treatment the tree may be so managed as that not only moderate, but even diminutive growth may be induced, and thereby gain not only the desired form in a small space, but, when the seasons allow, abundant fertility.

The whole secret lies in preventing unnecessary growth. Instead of allowing a tree to bring forth a great number of rampant shoots, which must ultimately be cut away, stop every excess of the kind. Every bud threatening to push in a wrong place, should be rubbed off; and every shoot not wanted to complete the form, should be stopped when not more than three inches long. The month of May is the proper time for this indispensable work in the garden; sooner or later, however, according to the season. By stopping all the unnecessary growth of the head, the roots are also moderated, and send up no more nutriment than what is absolutely necessary for the demands of the head: thus inducing an equable condition of the system, producing the desired results. Moderate growth induces the maturation of flower-buds; and though these may become too numerous for the strength of the tree, it need not suffer, while thinning the flowers and fruit is so easy a task.

There are other modes of checking the too luxuriant growth of a tree sometimes had recourse to by orchardists: viz. taking up and immediately planting it in the same place; or cutting out a hoop of the bark of the stem to partially stop the ascent of the sap; or, which has a similar effect, tying a band of tape or string very tightly round the stem to produce strangulation. These expedients may answer the purpose; but the most natural is disbudding.

Apple-trees may be unproductive and unthrifty through extreme weakness. This is often witnessed in old orchards, or in the case of very old trees; and is usually attributed to the cold wetness of the subsoil. If the stem be not hollow, the tree may be renovated by digging-in fresh soil, or well rotted manure, about the roots to a considerable distance round the trunk; and by scraping or drawshaving off all the dead outside bark (even down to the liber) from the stem and large branches; or, as a last resource, taking off the head of the tree altogether, to cause the production of a new set of branches. Such treatment may be worth the trouble to save the life of an old favourite; but planting young trees to succeed the old is the best management.

The following are a few of the most esteemed sorts:—

For the table.—White Astracan; Beachamwell; Borsdoffer; Borovitsky; Breedon pippin; Bringewood pippin; white Calville; Cambusrethan pippin; Cockle pippin; cole, or scarlet perfume; court pendu plat; court of Wick; Downton; Dutch mignonne; Essex pippin; Cornish gillyflower; golden drop; golden Harvey; golden pippin; Grise; Ingestrie; Juncating, red and white; Margil; Newtown pippin; nonpareil; Oslin; scarlet and winter pearmain; pomeroy; golden rennette.

For the kitchen.—Baldwin's Suffolk Beaufin; belle bonne; burr knot; Caroline; Carlisle codlin; Dutch codlin, English codlin; Fearn's pippin; gloria mundi; Gravenstein; Hawthornden; Lucombe's seedling; Minshal crab; royal russet.

For cider.—Coccagee; Cyder sop; Damelot; yellow eyelet; Glasbury; Gregoire; hard pippin; Hogshead; House; John apple; Norman styre.

APPLE BERRY (Smith). Otherwise called by botanists *Billardiera scandens*, a genus of climbing plants introduced from Australia. Linnæan class and order *Pentandria Monogynia;* natural order *Pittosporeæ.* Generic character: calyx five-cleft, coloured; corolla connivent, forming a tube; stigma, two-lobed; berry, two-celled with many seeds; seed smooth.

APRICOT. A well known wall fruit. Linnæan class and order, *Icosandria Monogynia;* natural order *Rosaceæ.* Generic character: calyx somewhat bell-shaped, five-cleft, deciduous; corolla five-petaled, roundish, inserted in the calyx; stamens attached to the opening of calyx; filaments like threads; anthers erect, egg-rounded, two-celled; style simple; stigma headed; drupe roundish, smooth, with a longitudinal furrow; nut compressed, suture prominent, smooth; embryo inverted, seed leaves fleshy.

The fruit has its name (*A. præcox*) from the circumstance of its ripening early in summer. It is one of our earliest flowering trees, and the first wall fruit that comes to table. Although commonly trained to walls, a variety, called the Breda, ripens pretty well, in the latitude of London, on standards in the open ground, if planted in a warm soil and sheltered situation. The necessity, as well as the custom, of making the apricot a wall tree, is attended with two disadvantages, viz. the heat and shelter of the wall brings out the flowers so early that they are in jeopardy from night frosts; and the branches being all trained on a vertical plane, induces an inconvenient growth of breastwood, which, without constant attention of the manager, is a waste of vigour, and injurious to the regular form of the tree.

To secure, however, the health and beauty and fruitfulness of this tree, moderate growth must be induced by the system of disbudding, as recommended in treating of dwarf-apple trees. The habit of the tree is to produce strong shoots from the stem and lower parts of the branches. This, though a lucky circumstance in a tree trained in the fan manner, occasions constant inspection and labour to prevent them shooting into large unfertile branchlets, which must be, either in the summer or winter pruning, cut away. If moderate growth be obtained by stopping irregular growth, the roots will never become too powerful for the head; and the well-placed summer shoots being carefully laid-in close to the wall, in every vacant part, abundance of bearing wood will be obtained to give flowers and fruit in every favourable season.

The apricot tree is one of those that produces short shoots, commonly called spurs; those are almost always fruitful; and should be preserved by the pruner, while they are yet but a moderate distance from the face of the wall. When these, however, gain an unsightly length, they should be displaced; because the safety of the flowers and maturity of the fruit, depends on their closeness to the wall. The shoots of the past year, provided they are of moderate size and well ripened, bear in this, the finest fruit: and there is one peculiarity respecting these shoots which deserves attention. If any shoot continues to advance till late in the summer, it is rarely fruitful: but if stopped some time before the growth naturally ceases, the buds on its lower part will be formed into flowers; but if stopped too soon, these same buds will burst into tufts of leaves only.

Except for standards or riders, this tree is usually budded near the surface of the ground, for the purpose of being trained in the fan manner; which, for general purposes, is certainly the most eligible: other modes of training, however, may be adopted, viz. with an upright principal stem and horizontal branches; or with a tall upright stem, with the branches trained downwards. These unnatural positions of the branches, it may be observed, are only means of moderating the growth to induce fertility.

The apricot is commonly budded on plum stocks; some kinds, as the moorpark, are worked on their own stocks, i. e. stocks raised from apricot kernels. If the young trees be intended for riders or standards they should be budded on the Saint Julian plum.

The tree is readily injured by wounds: and therefore the utmost care should be observed that no necessity arise for taking off large limbs. The heartwood is not durable, and if long exposed to air, as in a large wound it must be, it quickly rots and brings on general decay. For this and other reasons, as soon as the tree attains its natural size, or has filled the space assigned to it, every expedient should be practised to keep it stationary; no excess of growth being allowed, except only the ordinary succession of young wood for bearing.

The apricot, like other icosandrious plants, is apt to blossom too early in the spring, and on this account requires at that time some kind of shelter from night frosts. Copings, projecting from four to six inches over the face of the wall, are a great security: or curtains of net, bunting, or light canvass, fixed to the top, and let down every evening, defend the flowers sufficiently; and, moreover, may be used for another purpose, too often neglected, viz. for *shading* the flowers in the middle of the day from hot sunshine, which very frequently destroys many more flowers than are killed by frost in ordinary seasons. It is on this principle that the old common custom of protecting the flowers with small twigs of evergreen trees is so effectual. These twigs being regularly stuck in between the upper branches and the wall, hang drooping over the lower parts of the tree; and remaining throughout the flowering and setting season, act both as a shelter and a shade.

This treatment is required by all early flowering fruit trees, apricots, peaches, nectarines, and particularly plums and cherries, on south walls. Retarding the flowering by every possible means is also a good plan: and it may be observed of the apricot (as well as morella cherries, plums, &c.), that, in the latitude of London they do better on an eastern or western aspect, than on one due south; not only because the flowering is retarded, but also because the ripening fruit become too soon mealy on a south wall.

The best varieties of the apricot are the Moorpark, Breda, Masculine, and Brussels; all which ripen in the months of August and September. Besides their value in the dessert, they are convertible into many descriptions of confectionary; and the green fruit (necessarily thinned from the tree before stoning), is useful for tarts.

APSEUDES (Leach, Eupheus, Risso). A small but remarkable British genus of *Crustacea*, belonging to the order, *Isopoda*, and section, *Heteropoda*, having seven pairs of legs, of which the second pair is very large, dilated, and notched, somewhat like the fore legs of a mole; whence the species has been termed *Cancer gammarus talpa* by Montague. The tail is terminated by two long filaments. It is found amongst marine plants. This genus may be regarded as the type of the family *Apseudidæ*.

APTENODYTES—the Patagonian penguin. A genus of aquatic birds inhabiting the sea, and the last of a very peculiar and well marked family, which are closely allied to the divers, but yet differ from them in some particulars. The first of that family may be considered as the common auk, or razor bill, or perhaps the puffin, as both of these are excellent divers, but have their legs placed far backwards, are very bad walkers, and cannot stand but in an erect position, supported on the whole length of the tarsi. After the auk there is an intermediate genus, which used to be classed along with this one, and of course called by the same name; but there are differences, especially in the structure of the bill, which render it more advisable to separate them in a systematic arrangement, though they are all popularly known by the name of penguins.

The generic characters of the Patagonian penguin are, the bill longer than the head, slender, straight, a little curved at the tip; the upper mandible furrowed throughout its length; the under one wider than the upper at the base, and covered with a smooth skin; the nostrils in the upper part of the bill concealed in front by feathers; the legs very short, thick, placed far backwards; four toes on each foot, all turned forwards, three of them of considerable length and completely webbed, the fourth one very short; wings merely rudimental, quite unadapted for flying, and the feathers on them having nearly as much resemblance to scales as to ordinary feathers.

These birds can swim and dive well, but they are rather the inhabitants of the lonely shores, than discursive over the sea. Indeed, none of the wingless birds have the habit of making long excursions. That they should not, is a wise provision of nature; because they are mostly inhabitants of seas liable to be agitated by violent tempests; and as they are in general heavy birds, they would be ill able for contending with the agitation of the water produced during these. This genus is found on the Antarctic shores, most abundantly in the creeks of the southern part of the American continent, and of the island of Terra del Fuego; but they are also met with in various others of the southern islands. They do not move equatorially, or appear to leave their localities at any season; and they are so unsuspecting, that they may be taken with the hand, or knocked down by a stick. For particulars of this and an allied genus, see PENGUIN.

APTERA—wings wanting. A name first employed by Aristotle, and subsequently by the early systematists, and adopted by Linnæus to designate all those species of articulated animals furnished with articulated legs, which are destitute of wings during the whole period of their existence; another peculiarity exhibited by these animals being that, unlike the winged insects, nearly the whole of them acquire their perfect form, on escaping from the egg, the only change which they undergo consisting of an increase of their size, as in quadrupeds, or more properly, resulting from a series of moultings, as in the serpent tribes. In the system of Linnæus this order contained 290 speices, distributed in the following manner:—

A. with six legs, and the head distinct from the thorax, containing the genera, *Lepisma*, three species; and *Podura* (or spring tails), fourteen species; *Termes* (or white ants), three species; *Pediculus* (or the lice), forty species; *Pulex* (the flea), two species.

B. with fourteen legs, and the head united to the thorax. *Acarus* (or the mites), thirty-five species; *Phalangium* (or the harvest spiders), nine species; *Aranea* (the spiders), forty-seven species; *Scorpio* (the scorpion), six species; *Cancer* (the crabs and lobsters), eighty-two species; *Monoculus* (the water fleas), nine species; *Oniscus* (the wood lice), fifteen species.

C. with numerous legs, and the head separate from the thorax. *Scolopendra* (or centipedes), eleven species; and *Julus* (or the millepedes), eight species.

In the days of Linnæus, however, the structure, and more especially the internal organisation of these apterous insects had been so little attended to, that we can scarcely but feel surprised, whilst considering that the formation of these different generic groups presented modifications of far higher rank than those by which the genera of the beetles or other winged orders were distinguished from each other, that in so imperfect a sketch as the above, the traces of those higher distributions should be observed which the more minute investigations of modern naturalists have rendered necessary; thus, if from the first division A. we remove the genera *Termes* and *Pulex* which undergo transformations, we shall have a division corresponding with the sub-class *Ametabola* of Leach, which see; the genera *Acarus* and *Aranea* constitute the modern class *Arachnida*, which see; and *Cancer monoculus* and *oniscus*, that of the *Crustacea*, whilst the two genera composing the section C. are formed into the modern division *Myriapoda*, each being the type of an order, namely, the *Chilognatha* and *Chilopoda* of Latreille and Leach.

The original name of the order thus separated into so many other divisions, has been employed by entomologists in various manners, so that unless the student be put upon his guard he would be greatly perplexed in consulting the valuable works in which such variations occur. Thus Lamarck, having established the class of arachnida, and removed all the other genera to different classes, with the exception of the *flea*, retained the original name of *aptera* for the order established for the reception of that insect, in which respect he has been followed by Mr. Macleay. Messrs. Kirby and Spence, on the contrary, proposed the name of *aphaniptera* for the order of the fleas, and applied the term *aptera* for the spring tails, the mites and harvest spiders, the centipedes and millepedes, all of which they introduced into the class insecta, retaining the spiders alone in the class *Arachnida*, whilst Latreille, considering the arachnidæ in a wider extent, and the *Myriapoda* as distinct classes, has employed, in some of his later works, the term *aptera* as a primary section of the true insects consisting of the Linnæan genera, *Lepisma* and *podura*, *pediculus* and *pulex*.

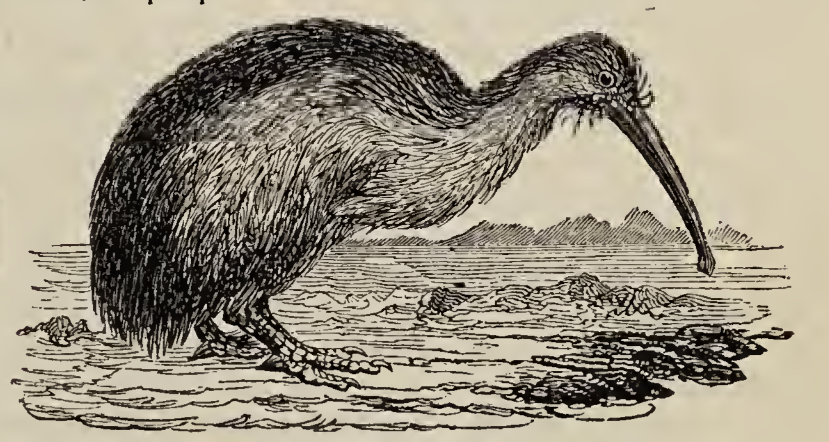
As, however, the group, which it was originally proposed to designate by the name of *aptera*, has been broken up into so many different sections, it would certainly seem to be a matter of convenience that the name by which, as a whole, these groups were known should be no longer employed; if, moreover, no other motive existed than that of removing all the confusion above detailed, by the employment of a more restricted nomenclature, we should feel but little hesitation in rejecting the term *aptera* altogether; but as the occasion for its employment is no longer requisite, we shall regard the order, containing the genus *pulex*, as entitled to the term *aphaniptera* (which see), as proposed by Messrs. Kirby and Spence; whilst with Mr. Macleay we shall regard the centipedes, millepedes, spring tails, and lice, as the types of so many orders in the class of *ametabolia* in a more extended sense than as defined in p. 91, whilst, with Latreille, we shall regard the *arachnida* as containing not only the spiders and scorpions, but also the mites which Dr. Leach regarded as forming a class by themselves.

APTERYX—the wingless bird of New Zealand. A most extraordinary species, genus, family, and—as one may almost say—order of winged creature, of which the characters, so far as they are known, clearly enough demonstrate that it is a bird, but they as clearly demonstrate that it does not come within any of the orders into which other birds are arranged in the systems. All that is known of it is a single skin, with the bill and feet attached, unmutilated, and in a good state of preservation. This skin was brought from New Zealand in 1812, by Captain Barcley of the ship Providence, from whom it passed into the hands of the late Dr. Shaw, and after the doctor's death it was purchased by Lord Stanley, in whose possession it now remains. Dr. Shaw described it in the 24th volume of the Naturalist's Miscellany, and accompanied the description by a figure; and that description and figure form the only sources whence Temminck, and some other foreign naturalists, who have noticed the bird, obtained their information. But Dr. Shaw, though a laborious collector, and voluminous compiler, was by no means a philosophic naturalist, and therefore his figure was not very accurate, and his description by no means calculated either to draw much attention to the bird, or to put inquirers in the right way of discovering its natural relations or affinities. Some foreign naturalists went even so far as to question the existence of the bird, though in the same work, and in the adjoining page, the very same author mentions it, under its New Zealand name of *Kivi Kivi* (most likely an imitation of its cry), as being abundant in the forests of that country. Of course, no characters are described along with the mention of the Kivi Kivi, because, though many of the voyagers frequenting New Zealand have often heard the natives mention the name of the bird, the places where it is found, and some of them have seen the chiefs with cloaks ornamented with the skins, so as to leave no doubt of the identity of the Stanley specimen, yet it does not appear that any European has seen either bill or foot, except in that specimen.

Lord Stanley sent the specimen to the Zoological Society, where the skin was so carefully examined as to ascertain with certainty that there is no deception in it; and a new figure and description, more in accordance with the analogies of the bird, were drawn up by Mr. Yarrell, with his usual accuracy. Of this figure, prepared under the directions of Mr. Yarrell, we give an accurate view in the next column; and we cannot convey a clearer idea of the appearance of this extraordinary creature than in that gentleman's words.

"The whole length of the bird," says Mr. Yarrell, "from the point of the beak to the end of the body (for there is no tail), is 32 inches; the beak is of a light yellow brown colour, long, slender, smooth, and polished, in form resembling that of an ibis, but rather more straight, and depressed at the base; length from the gape to the point, six inches and three quarters; the upper mandible is grooved in each outer side, near the margin, throughout its whole length; at the end of this groove, at each side, the nostrils are pierced, the apertures elongated and covered by a membrane, so suspended on the outside of each of these like a valve, that the slightest pressure against the outer surface when flexible, as during life, would render the nostrils impervious, and effectually defend and cover them. A bristle introduced into the nostril, under and behind this defending membrane, passes up the whole length of the beak. The upper mandible terminates in a blunt truncated knob, projecting a little downwards, behind which, on its under surface, the end of the lower mandible ranges when both are closed. The lower mandible is also grooved slightly near the outer edges throughout its whole length. Both mandibles are broad and flat at the base, measuring full one inch across at the gape, and only seven lines in height. The breadth of the upper mandible at the point is two lines, under mandible still more narrow.

"Throughout the whole length of the upper mandible and the distal three-fourths of the under one, the inner or opposed surfaces of both are perfectly flat, producing, when pressed together, uniform and entire contact, and well adapted for compressing or crushing such substances as may be selected for food. The proximal fourth of the lower mandible is concave on its inner surface, affording space for the tongue, which must, in proportion to the beak, be small and short.



Apteryx.

"The form of the body in this preserved specimen is that of an elongated cone placed nearly upright over a pair of short and stout legs, and the bird is thus made to resemble a penguin. In the figure annexed to the present description, the position and character assumed for it is that of the *Struthious* birds, in accordance with its real systematic relations.

"From the crown of the head to the lower end of the body, the length is twenty-four inches; and the circumference at the lower part eighteen inches. The feathers on the top of the head and forehead are short, and the skin carried forwards over the base of the beak to the extent of an inch, is covered by a mixture of dark feathers, bristles, and hair. About the gape on each side are also several long black bristles. The feathers of the neck are somewhat longer than those on the head, and they increase in length generally in proceeding downwards over the body. Those of the head and neck are of a hair brown colour, with the shafts lighter; on the back, sides, and rump, the shafts and inner portions of the webs are reddish, yellow, brown, and the edges dark brown, producing an agreeably variegated appearance. On the lower part of the neck in front, the breast, and the belly, the feathers are lighter in colour than on any other part of the body; the shafts still lighter than the webs, and greyish white. The feathers generally are uniform in structure, and resemble those of the *emu;* but each feather is much shorter, the longest (those hanging over the rudimentary wings) not exceeding four inches and a half. The webs are of greatest extent, most flocculent and silky at the base of each feather, and become more linear and shorter towards the end; the whole of the fibres forming the web are disunited, and the shaft has no secondary or accessory plume.

"On each side, about midway between the head and lower end of the bird, is a rudimentary wing consisting of three distinct portions.

"The part of the *humerus* that remains is about one inch in length; and from the appearance of the fractured end of the bone within the skin, was broken off clear below the head; the radial portion, figured by Shaw, appears to be made up, as far as can be ascertained by present examination, of two distinct bones, each about one inch and three-eighths in length, covered with a corrugated skin, and ending at the carpal extremity in a small horny claw, supported on a short ungual (heel) bone, the two portions in conjunction measuring about three-eighths of an inch.

"To the radial portion of the wing several feathers are attached of the same character as those of the other parts of the body; but the feathers above and behind this rudimentary wing are longer than those of any other part of the body, and, being directed forwards and downwards, entirely cover and conceal this small and useless wing.

"As far as I am able to judge by the preserved skin, the *femur* was probably three inches in length, the tibia about five inches; the articulation of the tibia with the *tarsus* is one inch and three-quarters below the end of the body, and on a line with the pendent ends of the plumage of that part. The *tarsus* is three inches in length, and measures two inches and an eighth in circumference. The other bones of the leg appear to have been like the tarsal bones thick and strong. The tarsi are covered with hard and dense reticulated scales, larger in size, and arranged in transverse lines in the front and behind, but smaller and more irregularly distributed on the sides.

"The toes are four in number on each foot, the three anterior toes entirely unconnected. The middle toe is two inches and three-eighths in length; the claw one inch; the inner and outer toes on each side are equal, and measure one inch and three-eighths; the claws very nearly as large and as long as that of the middle toe.

"On their upper surface, these toes are covered with a series of broad imbricated scales, arranged in succession transversely; the under surface is defended by very small reticulated scales, and the lateral linear junction of these two coverings is marked by a well-defined but slightly prominent ridge, which appears to have been mistaken for the remains of an interdigital connecting membrane.

"The claws are slightly curved, and taper gradually to a point; those of the middle toes are convex above, concave beneath; those of the inner and outer toes are also convex above; but the worn edges of the under sides give them a convex form beneath also, and they resemble a spur curved downwards. The hind toe is placed on the inner flattened surface of the *tarsus;* it is directed backwards, and almost perpendicularly downwards. The connecting bones are articulated so high up on the *tarsus*, that the extreme point of the claw scarcely reaches the ground. The whole length of the hind toe is but one inch and an eighth, of which the claw measures three-quarters of an inch. In form it is nearly straight, round, tapering, and pointed, and has much more the appearance of the spur of a *gallinaceous* bird than the claw of a hind toe. The *tarsi* and toes are yellowish brown, all the claws of a shining whitish horn colour.

"The decided rotarial nature of the legs and feet, with the very elongated form of beak common to a different order of birds thus combined in the apteryx, present considerations of the highest interest to the ornithologist; and it is to be regretted that little or nothing is known of the habits of a bird possessing parts and peculiarities of such distinct and different character. Its short legs and divided toes prevent progression in water, and equally deny compensation for the want of the power of flight. It is obvious that it possesses no efficient means either of escape or defence. Its food is unknown; but Colonel Sykes having found beetles, grasshoppers, worms, seeds, and vegetable fibres in the stomachs of some of the Indian species of *ibis*, I am induced to conjecture that the food of the apteryx is probably similar, or perhaps even still more exclusively insectorial.

"No public or private collection is understood to possess another specimen of this singular bird; and it might reasonably be expected that so defenceless an animal must soon fall, even to extermination, when assailed by powerful and ingenious enemies."

The apteryx is not represented as being generally distributed over either of the two islands of which New Zealand is composed, but to be found chiefly in the mountainous, dry, and stony tract near Cape East, on the eastern side of the northern island. The mountains there are not nearly so high as in the southern island; their climate is warmer, and they are interspersed by rich grounds, though without those forests of large trees which are found on the slopes of the more alpine places and in the morasses between. The climate is rather humid, and that, with other circumstances, leads to the conclusion that, under small stones and in the shallow crevices of rocks, there should be an abundant, and, generally speaking, a perennial supply of insect food; and it is probable that such is the principal subsistence of the apteryx.

Voyagers, who have seen the feathers adorning the mantles of the chiefs, have considered them as belonging to a species of emu, smaller and brighter in the colour than the emu of Australia; and the feathers are certainly very much of the same structure. But it must be borne in mind that neither the emu nor the apteryx has any of what may be called working feathers, conducive either to motion through the air, or to the direction of motion along the ground. The whole of their feathers, except in so far as, in the apteryx especially, the bristle-like ones may protect the eyes and the proximal part of the gape from injury, are wholly clothing feathers; and therefore the only inference than can be drawn from the similarity of structure is, that the two birds are exposed to pretty nearly the same kind of weather. Their feathers are a sort of pendent thatch, well calculated for throwing off the heavy rains which fall in those countries, and their loose and flocculent nature makes them also a good protection against the heat of the sun during the dry season. Thus far there is a resemblance between the two birds; and thus far we can see the necessity for that resemblance, in the analogy of the climates. But here the parallel ends; and in the present state of our knowledge, we are not able satisfactorily to continue it by a reference to any other known species of bird.

The grand deficiency is our total ignorance of the internal structure, because from that alone we could ascertain whether the bird feeds wholly upon insects and other small animals, or whether it occasionally has recourse to vegetable food. That its food is not the same as the food of the emu, or the other struthiones is evident from the form of the bill; and though reference has been made to the probability of its feeding on the same substances as some of the species of ibex, the difference of the bills is so great, and that of the apteryx is so peculiar and unique as to forbid any satisfactory analogy. The feet too forbid any comparison with the struthiones, or with the grallidæ, as they are neither adapted for swift marches nor for wading. They are, as Mr. Yarrell justly observes, rasorial, or scraping feet, bearing more resemblance to those of some of the gallinaceous birds, than to any others. They are strictly dry land feet; very robust and powerful, apparently capable of scratching up earth and gravel with considerable effect, and also forming a firm base either stationary or during slow motion. The bird cannot from its structure be a traveller, but must find its food within a limited range; but whether it seeks its food during the heat of the day, or in the twilight or moonlight, is not ascertained. Neither is it ascertained whether it nestles in the holes of the rocks, or squats upon the open surface. The New Zealanders are indeed said to hunt it during the night with torches and dogs, which would lead one to suppose that it remains hiding during the day. The information is so scanty however, that not even a satisfactory guess can be hazarded respecting its habits.

From the familiarity of the natives with its name of *Kivi Kivi*, it is natural enough to suppose that it is not very rare in those localities which are suitable to its habits. From this it may seem strange that, considering the number of Europeans who have visited New Zealand, and the length of time that some of them have resided there, and the familiar terms on which (while they conducted themselves properly) they have been with the natives, none of them should have once seen the bird in the living state. But it must be borne in mind that the New Zealanders are rather a shrewd and sagacious people, and do not very readily point out to foreigners those productions of their country upon which they themselves set the highest value. We had an instance of this when a ship was fitted out to fetch home, for naval purposes in this country, a load of that excellent and durable timber of which their war canoes are constructed. There is a much more showy tree than the valuable one; and they readily conducted our people to where that grew, and a load of handsome spars, and even masts, was procured with no great labour, and in a short time; but, unfortunately, when the vessel arrived in the Thames, the whole cargo was rotten, and good for nothing. The skin of the apteryx seems to be held in even more estimation than the canoe timber, and therefore the probability is that they are more jealous in keeping strangers from its haunts. So that the only way of arriving at the natural history of the bird seems to be by an independent excursion; and that, armed as the New Zealanders now are, would be a matter of no inconsiderable hazard.

APTINUS (Borelli). A genus of the bombardier-beetles, belonging to the great family *Carabidæ*, and sub-family *Brachinidæ*, separated by Bonelli from the genus *Brachinus*, to which the species are very nearly related, on account of their being destitute of wings—a character indicated by the name. In their habits they resemble the *Brachini*, but they are generally found in mountainous districts in warm climates, as in the south of Europe, the Cape of Good Hope, &c. Dejean, in his new catalogue, gives fifteen species belonging to this genus, none of which are found in England. A memoir, by M. Solier, upon this and the allied genera, has just been published in the Transactions of the French Entomological Society, from which it would appear that the absence of wings is not an exclusive character of the genus, but that the species are sufficiently distinguished from the *Brachini* by the presence of a tooth in the centre of the chin (mentum).

APUS (Scopoli). A very curious genus of *Entomostracous* (or soft shelled) crustaceous animals, belonging to the order *Branchiopoda*, section *Phyllopoda*. The body of these singular insects is covered by a large and flattened membranous plate of an oval form, with a deep cleft at its hinder extremity, and bearing in front two large eyes, placed close together, with a smaller one behind; the tail is terminated by two long threads; the first pair of legs, or antennæ as they have been considered by some authors, are very long, thread-like, and branched; but all the rest, of which there are about sixty pairs, are short, compressed, and of a complicated structure, serving as a branchial apparatus.

These animals are occasionally found, in considerable numbers, in fresh water, particularly such as is stationary; in which situations they are sometimes observed to be produced in so instantaneous a manner that it is difficult to conceive whence they could have been brought, this is more especially the case in puddles of water caused by heavy rains: it is evident, however, that the eggs of these animals must be endowed with great powers of vitality, by which means alone, as in the genus *Anabas*, which is occasionally observed under the same circumstances, we are able to account for their sudden appearance. They subsist chiefly upon tadpoles. The distinction of the sexes has not been observed, some naturalists even supposing them to be hermaphrodite. When full grown they are about an inch and a half long. The species are very few in number, and of rare occurrence. The type of the genus is the *Apus cancriformis* of Latreille, or " le binocle à queue en filets" of Geoffroy's History of the Insects of the Neighbourhood of Paris, pl. 21, fig. 4.; Scopoli's name for this genus has been generally adopted, instead of that of *Binoculus* of Geoffroy, although the latter has clearly the priority in date. Hence, in order to avoid confusion in the family name of these insects with the bees, *Apidæ*, in case we were to form it from the name of the present genus *Apus*, *Apidæ*, we have deemed it advisable to adopt Dr. Leach's name of *Lepidurus*, the other genus, as the foundation for the name by which we propose to designate the family, namely, *Lepiduridæ*.

AQUAMARINE. A stone bearing this name is much prized by jewellers for its beautiful green colour. In a classified collection of minerals it is placed with the topaz; and under this title are included the mountain-green varieties of that mineral found in the soft rocks of Eibenstock, in veins and cavities in

Siberia, and we may add in alluvial soils, in the upper parts of Aberdeenshire. A variety of the beryl is sometimes called by the same name.

AQUARIUS (Schellenberg). A name proposed for some of the water-bugs. See HYDROMETRIDÆ, and synonymous with the genus *Hydrometra* of Fabricius.

AQUILA—Eagle. A genus of accipitrous or rapacious birds, belonging to the division of diurnal feeders, and to the natural family of the *Falconidæ.* In their general characters they may be described as intermediate between the falcons properly so called and the vultures; and, in their specific characters, some of them approach more nearly to the first of these groups, and others to the second.

Their general characters are: the beak very strong, nearly straight in the basal part, but much hooked toward the tip, without any trenchant tooth and corresponding notch as in the falcons, but with a flexure or deviation from the straight line, near the middle of the tomia. The nearer the species approximate to the falcons in their habits, this deviation from the straight line is the more conspicuous, and the curvature of the beak begins the nearer to the base; and on the other hand, the nearer that their manners approximate to those of the vultures, the tomia and also the greater length of the beak are straight. The tarsi are in general short and very robust, the tendons which they contain being among the most firm and rigid of animal substances. The toes are three before and one in the rear, firm and elastic, and armed with large and powerful crooked claws or talons. Those talons are very sharp at the points; and they are partially retractile, or rather they rise by the action of elastic ligaments as soon as the feet of the birds come in contact with a pinnacle of rock, or other perch; so that the whole base on which the bird rests is the padded parts of the toes, and the talons are reserved for their proper purpose in the economy of the bird—that of clutching and killing prey. The claws on the hind toe and exterior one in front are usually the largest. In all the species the toes are perfectly free in their lateral motions, so that they can clutch at four nearly equidistant points. In those which feed exclusively upon land animals, the toes have no other motion than this, and that of clutching together with great power; and they are, strictly speaking, tearing claws, round on their convex sides, but grooved with two sharp edges on their concave ones, so that while they clutch they tear and lacerate with those edges. In the species which subsist chiefly by fishing, the outer toe is reversible, so that the claws grasp two against two; and in these the claws are not grooved, as that would only tend to cut through the hold which the bird gets of the fish that it clutches in the water. The wings of eagles are very powerful both in their form and the strength of their feathers; but they are broad and rounded, and not adapted for so rapid a degree of motion, or such graceful wheeling in the air, as those of the falcons. They are, however, much stronger, and probably the strongest in the whole class of birds. The first quill is very short, and the fourth the longest in the wing; but so many of them are nearly of the same length that the wings have a blunt or truncated appearance. The tails of eagles are large and powerful, and capable of much motion, more especially great extension and breadth. All the feathers on the upper part of eagles, more especially those that approach nearest to the falcons, have a firm and almost metallic appearance; but those which approach the vultures have them rather softer; and in those which fish habitually, the under part of the body and the under sides of the wings are feathered something like those of aquatic birds. In the bolder species the feathers of the neck are long and pointed, and they are erectible when the birds are in a state of great excitement.

The eyes of eagles are proverbially keen and penetrating; and the sight is the chief and indeed the only sense upon which they depend in the finding of their food. Among the many fabulous stories told of eagles, of which there are more both in number and extravagance, than respecting perhaps any other genus of birds, it is reported that the eagle can fly sunward with the open eyes directed full upon that luminary, without any injury to her powers of vision. But the very structure of the bird prevents the possibility of its looking at the sun, or even looking upward to any considerable angle. The eyes are placed laterally, and they are shielded by projecting upper orbits and orbital feathers for the very purpose of defending them from the light from above, and rendering them more keen to that from below.

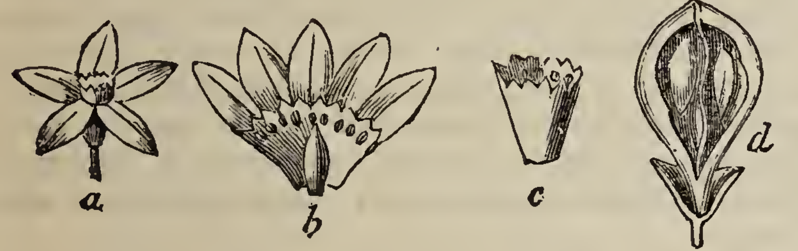
Eagles have indeed no occasion to look upwards, when they are in the air, or generally when they are in their dwelling places among the cliffs; for in both situations they themselves are, generally speaking, above all other living creatures; and though there may be some birds which, in peculiar situations and states of the weather, occasionally soar above the eagles' flight, yet those birds are, at these times at least, not eagles' prey. The power of eagles in seizing their food is in their descent; and they seldom if ever give chace on the wing, but descend or "stoop" upon their prey when it is on the ground. In that case their weight and their muscular energy together conspire to give them effect, and that effect is equally grand, and to the animals on which they prey, irresistible. But if they were to try hawking on the wing after flying game, they would fare but scantily; for their broad wings and tail make them turn so slowly and with so much difficulty that there are very few birds which would not throw them out so repeatedly, as to exhaust even their great strength in a fruitless chace.

The vision of eagles is no doubt wonderfully acute, as appears from the height at which they are found beating their pastures for even comparatively small game, and game which differs not much in colour from the vegetable covering of the ground. In these cases it is probable that their vision commands the whole of a circular horizon two or three miles in diameter, and that they can in a moment scan every point within that wide range. The surface immediately under them appears to be that which they command the least perfectly; and a perfect command of that would be of comparatively little advantage to them, inasmuch as an eagle cannot drop perpendicularly on its prey, but always in an oblique curve, by means of which it both delivers its whole impetus upon the prey, and prevents unpleasant collision with the ground.

Mammalia rather than birds seem to be the favourite prey of the more powerful eagles, either the smaller ones, such as hares or marmots in their full grown state, or the young of mountain goats, mountain antelopes, and other larger species. The eagles which inhabit the mountain ridges where these abound have, however, generally a spice of the vulture in them, and have no objection to feed, occasionally at least, upon those animals which fall a prey to the casualties of the situation or the climate. These species often fly very high, and beat as a pasture the summits of entire mountain ridges, discerning with much readiness the body of even a small animal in the deepest fissure or the darkest ravine. For a particular account of the haunts, habits, and economy of the principal species, we must refer to the article Eagle.

AQUILARINEÆ. A natural order of plants, nearly allied to the *Samydeæ*, *Chailletiaceæ*, and *Thymellæ*, and containing only a few genera and species. The plants included under it are as yet very imperfectly known, and their properties have scarcely been ascertained.

The essential characters of the order are as follows: Calyx turbinate, coriaceous, five-lobed; petals, none; stamens monadelphous, ten fertile, ten sterile; anthers two-celled, bursting longitudinally; ovary superior, one-celled; stigma short and simple; seed-vessel pear-shaped, two-valved, and one-celled, with the valves bearing the seeds; seeds solitary, with an arillus or tail. The plants are generally trees with alternate entire leaves, natives of Asia.



Aquilaria Malaccensis. *a*, Flower; *b*, the same opened to show the phycostoma; *c*, the phycostoma and stamens; *d*, section of the fruit and persistent calyx.

From the inner part of the trunk of the *Aquilaria Malaccensis* is, or *ovata*, and the *Aquilaria agalloch*, there is obtained a fragrant resinous substance called aloes-wood, or calumbac, the *bois d'aigle* of Sonnerat. This substance has a strong aroma, is employed as a cordial, and has been used in gout and rheumatism. The Cochin Chinese are said to manufacture a kind of paper from the bark of these trees.

ARA—maccaw. A genus, or perhaps rather a sub-genus, of *Zygodactylic*, or yoke-footed birds, belonging to the great natural family of the parrots and analogous genera; and in the gracefulness of their forms and the richness of their colours among the most beautiful of these very showy birds. Their principal distinguishing characters are, the cheeks naked of feathers, and the tail very long. Their attitude is graceful, and the colours of their plumage and also of the metallic reflections, are intensely bright. They have nearly the same complication and muscular furnishing at the bronchial end of the windpipe (the real organ of voice in birds) which belong to the rest of the family, but their natural voice is remarkably harsh and croaking, and they are far from sparing in the exercise of it. The word *Ara*, which is their name, they articulate naturally; and they can be taught to articulate other words, though not so easily as the parrots. Screeching is their favourite sound, in the exercise of which they occupy a considerable portion of their time; in other respects they are more sedate, less given to mischief, and do not so habitually tear things to pieces as the parrots; while their large size, handsome form, rich colours and graceful deportment, render them favourites in spite of their noise.

Ara.

They are all inhabitants of the warmer parts of America; and like the rest of the family seek their food and spend most of their time upon trees, in the holes of which the majority of them nestle, and some are said to excavate decaying trunks like the woodpeckers, though one species at least is mentioned as burrowing in the elevated banks of rivers and streams. Their food is the seeds of large forest trees, rather than the succulent pericarps of fruit, whether wild or cultivated; but they attack with great avidity the smaller cultivated fruits, such as coffee. They are not so social as most others of the family; being found in pairs, or at most two or three pairs together, more in juxta position than in society. The pairs are however, much attached to each other, and are said to divide the labours of nest-making and incubation pretty equally between them. They climb with great readiness, using both feet and beak, as is the habit with the whole family. On the ground they have very little command of themselves; for besides the general awkwardness of zygodactylic feet in walking, they seem encumbered by their long tails. When they can take wing from a height, however, they have considerable command of themselves in the air. For an account of the species see Maccaw.

ARACARI—*Pteroglossus*. A genus of *Zygodactylic*, or yoke-toed climbing birds, nearly allied to the Toucans, and sometimes regarded as forming only a section of that singular genus. See Toucan. There are, however, sufficient distinguishing characters to entitle the aracari to the distinction of being a separate genus. The feet are nearly the same, short, rather slender, with the toes grasping two against two, and therefore well adapted for climbing. The wings of moderate length, or rather short, and not fitted for long flight. The tail long, formed like that of the magpie, with the middle feathers much longer than the rest; and, as in the magpie, susceptible of extensive and rapid motion, so as to balance the bird when it shifts into various positions while clinging to a branch. The bill, however, is the grand means of distinction between these birds and the true toucans. The true toucans have the bill invariably thicker than the head, of great length, thin and transparent in the greater part, and often beautifully coloured, the colours fading almost instantly upon the death of the bird. The bill of the aracari is never thicker than the head, and seldom quite so thick, though it is still a bill of very ample dimensions. It is regularly curved in the culmen or ridge of the upper mandible, both mandibles are slightly bent at the tip, which is very sharp, and their tomia or cutting edges are toothed or serrated. The plumage is in general smooth, and the prevailing colours are green, marked with red or yellow on the neck and breast, and the green in some places passing into deep blue, and in others into black. There are several species, but they do not differ very materially in their appearance, and little, if at all, in their manners. The following figure will give a general idea of their form and the manner in which they sit on a branch.

Curl Crested Aracari.

These birds are all natives of the forests in the warmer parts of South America. They extend from Guiana to Paraguay, and also into Brazil; but, except South America, they are not met with in any other part of the world. The British birds which they most nearly resemble in their habits are magpies; but they are much less upon the ground, and more exclusively tree birds. They are, however, about the size of magpies, or, leaving out the great excess of bill, perhaps a little smaller; and they are more beautifully coloured. Though yoke-footed, they do not run along and inhabit the bark of trees, like woodpeckers, they fly with rather fluttering wings from tree to tree, and leap with great adroitness from branch to branch. In some respects they are omnivorous, but, as is the case with most omnivorous birds, they prefer animal food if they can obtain it. They live much upon the larger insects and their larvæ, and they are also great plunderers of the nests of smaller birds, eating with avidity either the eggs or the callow young, though it does not appear that they ever attack full-grown birds if in a state of vigorous health. Their vision is quick, and though, from the great size of the bill, the head cannot be jerked about so rapidly as that of a magpie, they have a good deal of the prying looks and peculiar habits of those thievish birds. They reside more in the wild woods, however, and come not often into the neighbourhood of human dwellings. Their colours are fine, and, though their lives are not very honest, their motions are often graceful; but, like all the rest of the gaudy climbing birds which inhabit the tropical forests, they have little to boast of in their music; their croak, or crash, or whatever else it may be called, is a single screech, something resembling the caw of a rook cut in two in the middle.

ARACHNIDA, Mac Leay (*Arachnides*, Lamarck and Latreille; *Arachnoida*, Leach). A class of articulated animals, the name of which is derived from Arachne, the name by which the spiders, which are the chief species contained in it, were known to the Greeks. The celebrated Cuvier, having by his invaluable discoveries in the comparative anatomy of the invertebrated animals, established the propriety of the removal of the Crustacea, as a *class*, from the apterous insects of Linnæus, *Aranea* and the remaining genera (with the exception of *Pulex*, as already noticed under the article APTERA) were shortly afterwards raised to a similar rank by Lamarck, under the name of Arachnides, having been previously regarded as a distinct *order* by Fabricius, under the name of *Unogata*, and by Latreille under that of *Acephala*. Lamarck, however, introduced into the class the centipedes, millepedes, spring-tails, &c., under the name of *Arachnides antennistes*, in addition to the spiders and scorpions, or *Arachnides palpistes*. The class has, however, been restricted by Latreille, Mac Leay, and most modern entomologists, to the latter, the former composing portion of the class *Ametabola*, or *Myriapoda*. Thus constituted the Arachnida are distinguished by their comparatively small size, their bodies in general being short and rounded. They consist of two parts only, the cephalo-thorax and abdomen, the head being so intimately united to the thorax that scarcely the slightest traces can be perceived of their union: whilst in others even the separation of the cephalo-thorax from the abdomen is almost equally imperceptible. Like the *Crustacea*, they are destitute of wings, and are not subject to those metamorphoses which distinguish the true insects.

The organs of respiration, upon which great stress has been laid as affording some of the primary characters of the group, consist either of internal air gills performing the office of lungs, and enclosed in pouches, or of radiated trachea, the spiracles or passages for the entrance of the air being from two to eight in number, and situated either at the lower part of the abdomen or the sides of the cephalo-thorax.

Messrs. Kirby and Spence have adduced various arguments of considerable weight against the union in the same class of animals whose circulatory system is so distinct as the trachean and pulmonary arachnida, and have considered the latter only as referable to the class, placing the trachean species in the class of insecta. Mr. Mac Leay, however, after a very careful examination of the chief types of the class in a living state, has defended, with his usual ability, the introduction of the trachean species into the class, and observed, that these "most evident arachnida" have no relation with the hexapod ametabola. See Zoological Journal, No. 18.

The anterior part of the cephalo-thorax generally exhibits on its upper surface a certain number of minute shining points, which are the organs of sight; they vary in number from two to eight, and furnish excellent characters for the distinction of the generic groups. Unlike hexapod insects, the animals of this class are furnished with eight very long legs, generally terminated by two small claws; in front of the legs are to be observed a pair of very powerful organs terminated by acute moveable hooks, which, in many cases, afford passages for the discharge of that poisonous fluid with which some of the insects are provided. These organs have been termed chelicera, by Latreille, who considers that they represent the antennæ of insects and the internal antennæ of the decapod crustacea, but so little attention has hitherto been paid to the comparative anatomy of these analogical organs that it is perhaps the safest course to regard such analogies as undetermined. In addition to such organs, the mouth is furnished with a lower lip and a pair of lateral moveable instruments, similar to the lower jaws of the mandibulated insects furnished externally with a pair of jointed appendages or palpi. All the arachnida appear to be earnivorous, but some are parasitic upon the bodies of other animals, and in these the mouth undergoes a considerable change of structure, being composed of an instrument capable of suction, although formed of the same typical number of organs as the mouth of the preceding.

The portion of the body, succeeding the cephalothorax, constitutes the abdomen; in general it is soft, more or less globular; on its under surface are to be observed a certain number of apertures or spiracles, and the anal aperture, as well as the spinnerets, when present, are placed at its posterior extremity.

The external covering of the arachnida may be regarded as of a leathery rather than a horny texture, but in some species it assumes a considerable degree of rigidity; it forms, however, in all cases an external skeleton, to which the muscles are internally affixed as in insects.

Of the senses of the arachnida it may be observed that, according to the best of our necessarily imperfect knowledge of such matters, they appear to possess all the five senses with which the higher animals are endowed; that the minute simple stemmata on the crown of the metathorax are eyes, and that these animals possess the sense of sight cannot be doubted; every body having observed the hunting spider (*salticus*) throw itself to a considerable distance upon its prey. Here it is evident that the instinct of the animal, acting upon the impressions produced by the possession of the sense of sight, induces it to do an act for the gratification of another sense, that of taste. In like manner the sense of touch is possessed in an eminent degree by these animals; and although the accuracy of the poet's observation, that the spider

"Lives in each thread, and feels along the line,"

has been called in question in a very popular work (Insect Miscellanies, p. 5), it is evident, from experiments which we have made for the express purpose of ascertaining the relative powers of the senses of sight and touch, that the latter is much stronger than the former. When a fly is caught in the web of a spider, the latter instantly stretches out its legs in the direction of the captured and struggling fly and feels, for in no other manner can we describe its proceedings, the nature of the disturbance which is taking place in its web. In the work above alluded to, it is stated, "We have tried numerous experiments, by moving and vibrating the lines of the webs of many species, so as to imitate as nearly as possible the entrapment of a fly, but in no case have we succeeded in bringing the spider to the spot, because, as we inferred, her eyes always detected our attempted deception." Now the experiments made by the author of this article have produced a result so contrary to the above, that it is not without a repetition of them that we have ventured to adduce them against the statements in question. These experiments were chiefly made upon the *Epeira diadema*, one of the largest of the British species, which, from its very common occurrence, beautiful markings, and elegantly-constructed web, must have attracted the attention of the most casual observer in the autumn. Now from its size it is evident, that, if the intelligence which these insects obtain respecting the entrapment of a fly, results from the sense of sight, the epeira would make no use of its legs for obtaining such knowledge, and that its eyes alone would be brought into action; but so far is this from being the case, that we have repeatedly disturbed the lines of the web, within an inch of the spider, *and in the direction of its eyes*, but in every instance the legs have been instantly put in motion, which has been continued for a considerable time even after. We have ceased the disturbance, in order that, if possible, the spider, by slightly moving the web itself, might set the fly, which it evidently supposed to have been captured, in motion again, so that, by its repeated struggles, it might ultimately fall an easier prey to the inhabitant of the web. But in addition to this fact, it is to be observed, that the den-like retreats of many spiders are so placed that they cannot possibly see any thing which occurs on the web, and yet no sooner is a fly entrapped in any part of the web than the spider instantaneously acquires a knowledge of the fact, evidently by touch, and darts out of its den upon the luckless captive. Thus we frequently find the spider deeply seated in the aperture of a wall, and the web extended to a considerable distance over its surface; and yet by the tension of the cords composing the net work, the spider is instantly made aware of what occurs on every part of its surface. Two instances are adduced in the work in question in support of the idea, that the eyes, and not the legs, are the instruments of knowledge to the spider. First, the long-bodied spider (*Tetragnatha extensa*) is noticed as having probably given rise to the popular opinion under review, notwithstanding it huddles its legs into a close bundle, and which is evidently done with the view of making them appear motionless, although the insect does not the less obtain information by their assistance; and immediately afterwards the long-legged house-spider (*Pholcus phalangioides*) is referred to, as giving more countenance to the opinion, because it keeps its legs spread out as if to feel the more readily when any thing is caught; although the more than usual prominence of its eyes is mentioned as showing the superiority of its powers of sight. We have noticed these contradictions, because as they occur in a work of great popularity, it is advisable that the erroneous impressions which they must necessarily produce ought to be counteracted as early as possible.

In the majority of the arachnida, a complete and very distinct system of circulation exists. The heart is contained in the abdomen, and in many species of spiders its pulsations are easily to be observed. It consists of a large longitudinal vessel which emits a certain number of arteries, and receives the veins by means of which the sanguineous fluid returns, after having been aerated by the respiratory organs, to be again distributed through the different parts of the body.

In this class, as in the insects, the sexes are constantly distinct, and impregnation is necessary for the fecundation of the eggs. Several striking peculiarities are connected with the act of impregnation, respecting which the most celebrated physiologists are at variance, and though the pages of the present work can hardly be considered a proper field for discussions connected with this subject, it may be proper to state that it was considered one of such importance, that, at the last meeting of the British Association for the Promotion of Science at Cambridge, the inquiry as to the true male organs of generation in the spiders was one of the three questions proposed relative to the annulose animals.

The development of the embryo of the spiders has been traced in a most elaborate manner by M. Heroldt, of which a notice will be found in the Insect Transformations, pp. 123 and 124. (Untersuch ungen über die Bildungs-geschichte dir Wirbellosen Thære im Eie. Marburg, 1824.)

From various observations, it is evident that the limbs of the arachnida are capable of reproduction when mutilated. This faculty, together with the longevity of some species, various peculiarities of structure, and especially the circumstance that some spiders engender more than once during the course of their lives, evidently prove the distance which exists between this class and the insects, and their greater proximity with the crustacea.

The habits of the arachnida exhibit much of popular interest, but as they vary greatly in the different families, it will be more convenient to notice them under the head of each group.

As to the classification of this class, it is to be observed, that we are indebted for the most part to the works of foreigners for those views which have been adopted in the modern arrangements of the annulose animals. In the work of our countryman, Lister, published in 1678, " Historiæ Animalium Angliæ tractatus de Araneis," are, indeed, to be found many very good coloured figures of British spiders, as well as the first attempt at their distribution ; but until within the last few years, arachnology seems to have been banished from the studies of British naturalists, and taken up its abode in France, where, under the hands of Savigny, Latreille, and, above all, the baron Walckenaer, it has arrived at a high state of cultivation. We may now, however, boast of the labours of Blackwall, published in the Linnæan Transactions and the Annals of Philosophy, as well those of an anonymous writer in a late number of the Magazine of Natural History, from whose admirable pencil and pen, British arachnologists may shortly hope to be furnished with a most invaluable series of memoirs.

The class, as at present constituted, has generally been divided into two orders, the pulmonary and the trachean arachnida; but in his last work, Latreille has established a third order, *Aporobranchiæ*, for a very remarkable group of animals, which Leach regarded as possessing so doubtful a situation, that in the Entomologists' Compendium, they were placed at the end of the true insects.

The class may therefore be thus distributed.

SECTION I. *Pulmonaria*, having pulmonary sacs for respiration, with six or eight simple eyes, consisting of two orders.

ORDER 1. The *Dimerosomata* of Leach, or the *Araneides* of Latreille, consisting of the great group of spiders, divisible into various families, having the abdomen attached by a foot-stalk, and not articulated.

ORDER 2. The *Polymerosomata* of Leach, or the *Pedipalpi* of Latreille, consisting of the scorpions, and divisible into two families, *Scorpionidæ* and *Phrynidæ*, having the abdomen attached by its whole breadth, and composed of numerous segments.

SECTION II. *Trachearia*, having tracheæ for respiration, never with more than four eyes, consisting of two orders.

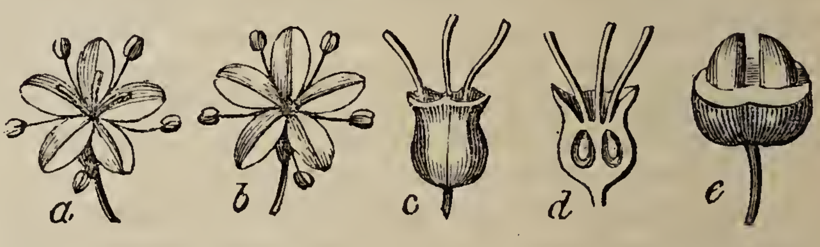
ORDER 3. *Adelarthrosomata**, or those trachean species which have the mouth furnished with visible didactyle chelicera, and the abdomen annulated, although occasionally in an indistinct manner.

Consisting of the families *Solpugidæ*, *Cheliferidæ*, and *Phalangiidæ*, or harvest spiders.

ORDER 4. *Monomerosomata* of Leach, or those trachean species which have the body formed of a single segment, the abdomen presenting no traces of articulation, and the mouth either suctorial or furnished with concealed didactyle chelicera. This order consists of the very extensive Linnæan genus *Acarus*, or mites, divisible into various families. See the article ACARI.

SECTION III. (ORDER 5.) *Podosomata* of Leach, or the *Aporobranchia* of Latreille. These singular insects are marine, they are not furnished with distinct spiracles, so that it is probable that respiration is effected by portions of the external covering of the body possessing the properties of branchiæ. The body is linear, and seems, as it were, to be composed only of the union of the legs; the mouth is tubular and porrected; and the females are furnished with an additional pair of legs, which serve only for carrying the eggs. This order consists of two families, *Pycnogonidæ* and *Nymphonidæ*.

ARALIACEÆ or ARALIÆ. A natural family of plants, the ninety-ninth order of the Jussieuan system, comprising seven or eight genera, and upwards of forty-three species. This family has a considerable resemblance to the umbelliferous tribe, from which it is distinguished by its many-celled fruit, and shrubby habit. The botanical characters of the family are : calyx inferior ; petals five or six ; stamens equal in number to the petals ; anthers two-celled ; ovary two or more celled ; styles many, simple ; berry two to fifteen celled ; generally trees or shrubs, rarely herbaceous plants : flowers small, collected into umbels, and provided with involucres.



PANAX QUINQUEFOLIUM. *a*, hermaphrodite flower; *b*, male flower ; *c*, calyx and pistils ; *d*, section of the ovary ; *e*, section of the fruit, showing the seeds.

This is a small order, containing plants which are not remarkable for the beauty of their flowers, although the foliage of many is extremely fine, as seen in the species of sciadophyllum and ivy The plants of this order are found in India, China, North America, and Europe. In their general properties also they resemble the umbelliferæ, being stimulant, aromatic, and occasionally narcotic. They differ, however, from the umbelliferæ in the qualities of their seeds. The roots of most of the Araliaceæ have a sweet aromatic flavour. Those of the *Aralia racemosa* and *nudicaulis*, resemble the parsnep in taste. The roots of the latter species are brought from North America, and sold as a substitute for sarsaparilla.

* In order to preserve the order of the mites entire, as suggested by Dr. Leach in the Supplement to the Encyclopædia Britannica, we have been compelled to establish a new order for the reception of the remainder of the trachean species, which we have named from the comparatively obscure articulation of the abdomen.

From the *Aralia umbellifera* an aromatic gum-resin is obtained.

Among the plants included under this family, the *Panax quinquefolium*, or American ginseng, particularly demands attention. This plant would appear to resemble closely the celebrated Chinese ginseng, which has been so much praised for its tonic, restorative and invigorating qualities. These qualities are said to be possessed by it only in the fresh state. The roots are washed and prepared in a particular manner by the Chinese. According to Father Huton, who has written a paper on the subject in the Philosophical Transactions, this root gives immediate relief after fatigue, strengthens the stomach, promotes the appetite, and gives a vigorous tone to the body even in extreme old age. The qualities of the ginseng have, however, been much exaggerated, and it is now scarcely ever used in Europe.

The ivy, with its beautiful evergreen foliage, adorning our walls and covering the trunks of trees, belongs to this family. The berries of the ivy were supposed by the ancients to possess purgative qualities; and an extract was made from them which was used in dropsy and jaundice. The leaves have been employed for dressing burns and blisters, and a resin is obtained from the stalk in warm climates, which is used to form a varnish.

ARAUCARIA. The Chilian name (Latinised) of a magnificent genus belonging to *Diœcia monadelphia* of Linnæus, and the order *Coniferæ* of Jussieu. This fine forest tree arrives at the height of one hundred and fifty feet, and with a trunk of proportionate bulk. It was introduced to England as long ago as the year 1796, but it is hardly hardy enough to bear the open air of Britain.

Araucaria imbricata.

In the royal garden at Kew, and at Dropmore, the seat of lady Grenville, there are pretty large specimens of this interesting tree, which require temporary coverings in the depth of winter. It is, however, expected that, as the plants increase in size, and when the growth becomes moderate, they will acquire greater hardihood, so as to be placed among and classed with our natural forest trees. We have as yet no good account of the quality of the timber, but presume that like others of the cone-bearing family, yielding a resinous sap, the wood must be durable. Congenerous species of this tree have been found in other provinces of South America besides Chili, and also in Australia; hence their names are not yet very well defined. The Chilian species now under notice has been called *Colymbca quadrifaria* by Salisbury; but this name has been set aside for the first, given by Ruiz and Pavon, viz. *Araucaria imbricata*, so called from the scale-like position of the leaves on the stem. Another even more majestic species has been found on and introduced from Norfolk Island, and at first was called *A. excelsa* in the Hortus Kewensis. This last, however, has been raised to the dignity of a new genus, under the name of *Altingia* (a German botanist) *excelsa*, by Noronha, the Spanish traveller. To this genus another species, found in New Holland, had been added by Mr. G. Don, which he has called *Altingia Cunninghami*. There is yet another genus of this natural order, found subsequently to the above mentioned in China, and named (in honour of the Messrs. Cunningham) by Dr. Brown, *Cunninghamia lanceolata*, and which is the *Pinus lanceolata* of Lambert, and *Belis jaculifolia* of Salisbury.

The regularity of growth in these genera is one of their most conspicuous characters; the exact symmetry of the Norfolk Island Altingia is peculiar; no other tree is more uniformly tapering from the base to the summit, nor so truly decussated in the branches diverging from the stem at equal intervals, in the most uniform manner. So much does regularity appear in the young trees, that they would be most repulsive objects to a flowing-handed painter if called on to represent them faithfully on canvass, because every one viewing his work would pronounce it to be done by scale and compass.

There is another peculiarity observable among this tribe of plants, viz. the definite constitutional structure and powers or tendencies of their several buds or parts. Their gems or buds are either principal, secondary, or tertiary. Of principals, each tree (if we except accidents) develops but one to form the stem, and which, until it gains its natural altitude, continues to ascend perpendicularly. This cannot be made to do the office or take the direction of a branch; so neither can the secondary order of buds, and which serve to produce branches, take or do the office of a leader. The third order of buds are produced from and along the sides of the branches, and when developed have usually a pendent or hanging character, rendering the tree very graceful, especially as they are again ramified at the points.

These trees have been propagated by layering and grafting; but if the scions or layers be the points of branches, the young plants, even by the most attentive training, cannot form trees of the natural character, they always taking a horizontal direction. If, however, a young perfect tree have its stem forcibly bent down upon the ground, latent gems will be put forth possessing all the properties of principals; and these, either layered or made grafts of, will grow up perfect trees.

Imported seeds, direct from Chili, are often found deficient on their arrival in this country. Lately, however, a collector has discovered a mode of transporting them in the greatest safety and perfection; so that we may hope to see thousands of perfect seedlings in every public nursery.

ARBOR VITÆ. An ornamental evergreen shrub or tree, called by botanists *Thuja*, of which there are ten species, natives of Europe, Asia, and other parts of the world. Linnæan class and order, *Monœcia Monadelphia;* natural order, *Coniferæ.* Generic character: male flower, catkin small and round; anthers four, sitting, somewhat globular and sealy at the base. Female flowers sealy, digynous at the top; embryo having two seed-leaves. These trees are usually planted in pleasure grounds, and answer the purpose of shrubs rather than trees, as they give depth and density to ornamental plantations. Like others of the coniferous tribe, they always add a richness to dressed scenery, whether standing alone on the lawn, or intermixed with other trees. Propagated by seeds.

ARBUTUS (Linnæus). Strawberry-tree. A genus of beautiful evergreen shrubs, natives of Ireland and South America, belonging to the Linnæan class and order, *Decandria Monogynia;* natural order, *Ericeæ.* Generic character: calyx, five cleft; corolla, pitcher-shaped, limb with five reflexed teeth; stamens inserted on the base of the corolla; filaments short, dilated at the base; anthers, two celled, opening by two pores at top, on the back a bristle; germen, disk ten angled; style, simple; stigma obtuse; berry of five cells, containing many seeds. Whether while in flower or in fruit, no shrub is more ornamental than the *Arbutus unedo* being both an elegant and hardy plant, showing to particular advantage in the months of October and November, when it is covered at once with blossoms and fruit. In Ireland it is found wild, growing on limestone rocks in greater luxuriance than in Italy.

ARCA (Linnæus, Lamarck, Cuvier). Fifth family, *Polyodonta;* third order, *Lamellibranchiata;* third class, *Acephalophora;* of De Blainville's System of Malacology. The body of these mollusks is thick, of rather a variable form; the abdomen provided with a pedunculated foot, compressed fitted for adhesion, and divided lengthways; the mantle provided with a single row of cirrhi prolonged rather backward; the buccal tentaculæ very small and very rough.

The Arcaceæ, as they are now established by modern naturalists, present a numerous and well defined genus, easily recognised by their general resemblance to the hull of a ship, whence they have derived their name, and by which they are distinguished from their congeners. The Linnæan genus Arca is very properly subdivided into three, *Arca, Pectunculus,* and *Nucula;* Lamarck made another, which he called *Cucullæa;* but it is restored by De Blainville to the arks; each of these genera possesses a strong distinctive character, fully sanctioning a separation from each other.

The shells of this genus are transverse, subequivalve, inequilateral; the apices distant and separated by the angular area or channel of the ligament, which is always external; the hinge is placed in a right line in most species; they are without ribs and furnished with numerous small sharp teeth, alternately inserted between others in the opposite valve; in many species the valves when shut, gape in the centre, occasioned by the wide flexuous curve of their outer margins, and sometimes one valve overlaps the other. They are said to spin a byssus, and are covered with a lamellar or velvet like epidermis, frequently ending in a deep fringe. The valves are longitudinally ribbed, imbricated, smooth, granulated, or finely striated.

De Blainville has divided the genus into six species; the first navicular with the hinge completely straight, the foot tendinous and adherent, as in the *Arca Noæ,* here figured; the second species is twisted,

Arca Noæ.

close shutting, and the hinge quite linear, as in the *A. tortosa;* the third boat-shaped, with a straight hinge, and the terminal teeth longer and more oblique than the others, *A. auriculifera,* constituting Lamarck's *Cucullæa,* so named from each valve possessing a small chambered portion or hood-like separation; the fourth species has a straight hinge, but it is not notched or gaping beneath, and the muscle of it is not adherent, *A. barbata;* the fifth species is perfectly close, they are of a less elongated shape, more pectiniform, and with a straight hinge; and the last division includes all that are elongated, a little arched lengthways, slightly gaping beneath, the summits much closer, the ligament nearly interior, and the dental line a little arched, *A. mytiloidea.*

Arca Barbata.

Lamarck enumerates thirty-seven recent species and nine fossil. De France mentions twenty-five fossil species, besides three of *Cucullæa.* They inhabit the sea in all parts of the globe, at a short distance from the shore; and, though not particularly distinguished for the richness of their colouring, they are many of them beautifully sculptured and of a very graceful form.

ARCHANGEL. The English name of a family of herbaceous annual and perennial plants, several of them indigenous to Britain, but not in cultivation. They are sometimes called "dead nettle" from their appearance, yet harmless character. Two of them, *Lamium orvala* and *L. flexuosum,* are admitted into the flower borders, but they are exotics.

ARCTOMYS—Marmot. A genus of mammalia belonging to the order of *rodentia* or *gnawers.* Like the rest of the order they are without canine teeth, and in the sharpness of the incisors of the lower jaw they bear some resemblance to the great family of rats and mice, of which perhaps they may be considered a sa subdivision, though, in some respects, they bear at least a slight resemblance to the squirrels, and their external forms and also their manners are peculiar. They have five grinders on each side in the upper jaw, and four in the under, the summits of which have sharp tubercles, so that they seem capable of subsisting on insects, and even on the flesh of larger animals, as well as on vegetables. Their bodies are thick and clumsy, their legs short and thick, their head large and flat, their ears short and blunted, and their tail short and apparently incapable of motion.

The Marmot.

Some of them inhabit the most bleak and dreary situations, the summits of the most elevated mountains, such as the Alps, and near the margin of the region of perpetual snow. The chief food of these is no doubt the hard alpine grasses, and other plants which are found in regions of so scanty vegetation; and these are found only for a part of the year, not more than half of it in the more elevated haunts of the animals. But in their habits they are as seasonal as the places where they reside; for when the cold weather sets in they descend into the depths of their burrows, and there remain in a dormant or hybernating state during the whole of the inclement season. Thus their years of activity are reduced to half years, and during these they are very slow in their motions, and at no time is there such action in their system as to occasion that waste and necessity for food which take place in more active animals. Accordingly, barren as their pastures comparatively are, they get very fat toward autumn; and are covered with lard like little pigs, or perhaps rather stored with grease like bears when they retire to their winter domiciles. Their hybernation, which is not, even in the greatest depth of its quietude, a total cessation of all the animal functions, is gradual at its commencement; and the recovery from it is also gradual. Owing to these circumstances, the fat is wholly absorbed by the time that the animals are able to come abroad; and in the brief space of their short year, they have to recover their strength, rear their broods, and again become fat preparatory to a new hybernation.

At all seasons they are ground animals, and spend the whole of their time, except what is taken up in feeding, in their burrows, which they dig with great ease and rapidity and to a considerable depth, always sloping downwards, so that the dwelling may be beyond the reach of the intense cold of the winter, and yet so contrived as to be in no danger of filling with water during the rains or the melting of the snow.

Some of them are animals of considerable size, not less than the common wild rabbit. But though easily taken, as their progressive motion is slow, and it is not very difficult to dig them out of their burrows they are of little value to mankind as game. In autumn, when they are fat, the mountaineers do eat them, but they are not very palatable to those who have a choice of food. It seems indeed to be a pretty general fact, if not a law, in warm-blooded animals, that the more sluggish the functions of life are, the flesh of the animal is the less palatable and the less stimulant. But though the marmots are thus not hunted with the same daring assiduity as the chamois and some others of their fellow mountaineers, they are still not without their destroyers, for the keen glance of the eagle is upon them as soon as they quit their burrows. There are various species, inhabiting different countries, and having different manners; for the details of which see the article MARMOT.

ARCTOTIS (Linnæus). A numerous family of herbs and under shrubs from the Cape of Good Hope. Linnæan class and order, *Syngenesia necessaria;* natural order, *Compositæ.* Generic character: anthodium scaly, scales squamose; receptacle bristly; pappus chaffy.

This genus of ornamental plants, though agreeing in essential character, are a good deal varied in habit: hence botanists have divided the family into five sections, founded on the different form of the leaves, nature of the stem, or on having no stem. Many of them have handsome star-like flowers, several are splendid; and the metallic tints reflected from the rays of the flowers are, in many of the species, very imposing. Of the shrubby species there are sixteen; and of herbaceous fifteen; some of the latter being annuals.

ARDEA—Heron. A very striking and by no means an uninteresting genus of birds, belonging to the order of *Grallidæ* or waders, and to the natural family of the *Gruidæ* or cranes. By the elder naturalists this genus was made a very extensive one, and species were included in it which had little analogy to each other in their manners, such as the cranes, the storks, the night herons, and the bitterns. There is even still a disposition to retain the bitterns in the genus by those who exclude the cranes and storks. But this is in violation of all natural affinity, because the bitterns really differ more from the herons than the herons do from the cranes and storks. The bitterns, no doubt, breed in marshy places, and spend the greater part of their time there; but in their food and feeding they have some slight analogy to gallinaceous birds, though, as they feed in secret, the precise nature of their food is not accurately known. There is reason to believe, however, that they feed chiefly upon worms, molluscous animals, the young of frogs, and other aquatic reptiles, and very rarely upon vegetable substances. They never migrate but from necessity, and that during the inclement season, and they are not seen on the wing except in the twilight, and then chiefly or exclusively during the breeding season.

The herons, on the other hand, do not breed in marshes, but on trees, near water if they can so obtain them, but on trees, whether very near water or not. They subsist almost exclusively by fishing; and they fish openly in the small streams, ponds, and shallows of lakes, often having to journey for many miles through the air to find food both for themselves and their young. It is true they are not found upon the waters during the heat of clear and sunny days; but then the cause of their not being so is in the prey more than in the birds. The cool of the morning and evening, but more especially the former, are the times at which the little fishes are most easily caught, and on that account the herons then resort to the waters. On dark and gloomy days, which often put herons' food in motion, one cannot always easily tell why, the birds are often by the water all day long. They often frequent the banks after floods to pick up the stranded or migrant fishes; of the latter of which eels form no inconsiderable portion.

In those countries which have dry and rainy seasons alternately, they are much more migrant than in temperate climates where the state of the waters is uniform; and when they are, as one would say, "dried out" in their native haunts, a few of those which belong to countries of the former character often straggle into the latter. The principal distinguishing characters of the herons are the bill long and strong, compressed laterally, and tapering gradually to the point, which is remarkably sharp. The general form is nearly straight, but sometimes a very little arched. The tomia are generally finely toothed or serrated, and the bill is furnished with a notch. The nostrils are lateral near the base of the bill, placed rather obliquely, and half closed by a membrane; from them slight grooves or channels proceed along the upper mandible, and are gradually obliterated towards the tip; and the gape extends as far backward as the eyes, admits of considerable distension, and is opened and closed with great rapidity. The eyes are surrounded by naked skin, which extends to the gape. The head is small but compact, and often furnished with a beautiful flowing crest to the hind head, which appears to guide and steady the stroke of the bill, in the same manner as feathering guides and steadies a dart or arrow. The neck is very long and slender, and remarkable alike for the rapidity and the grace of its flexures. In the true herons the lower part of the neck is surrounded by a sort of ruff or produced and pointed feathers, which appear to regulate the motions of that organ something in the same manner as the crest regulates the motions of the bill. The following figure will give some idea of the head and neck of the common heron, which in Europe may be regarded as the type of the genus.

Head of the Common Heron.

The body is very small for the apparent size of the bird; and in some of the species it is ornamented with very peculiar but very beautiful produced feathers arising from the scapulars or other parts of the back. The tarsi are very long, rather slender, but admirably protected from the decomposing action of water, and from changes of temperature, by the nature of their covering. They are always naked to their articulation with the tibiæ; and in some of the species these parts are also bare of feathers for half their length. The toes are three before and one behind; the hind one articulated on the same level with the others, but turned inward. The middle and outer ones are united by a small membrane at their bases; but it does not in any way approximate to the nature of a web, neither are the birds in any way adapted for swimming. The claw on the middle toe has a sort of prominent tubercle on its inner side; but the claws altogether are nails rather than organs either of prehension or perching. The fact is, that though the birds nestle and also rest themselves on trees, they stand rather than perch; and hence they are always so near the tops, that when they raise themselves on their long legs, they can extend their wings, and take flight without any interruption from the branches. The wings are very long; but they are rather blunt, and adapted more for forward flight than for turning. The second and third quills are the longest, and both of nearly the same length. The wings are hollow and take a great deal of air in their under sides; but though the flight when the bird is high and on a journey is by no means slow, it has a loose appearance, as the body is too light for affording a steady point of rest for the action of the wings, but plays upwards a little with their downward stroke, and downwards with their upward one.

Still, in places where they resort (and the common ones are social), herons are very ornamental birds, and, in all their attitudes when extended, give an idea of magnitide which their weight by no means justifies; and when a heron denuded of its feathers is compared with one of the same size in full plumage, it seems a mere skeleton, and but for the bill and the legs, one could hardly believe that the two birds belong to the same species. If there are fish-ponds near a heronry, the birds levy severe contributions upon the fish. Herons are also said to flatten and stunt the tops of those trees in which they take up their abode, as their mutings are acrid, and destroy both the leaves and the young shoots. Where they do take up their abode, however, they inhabit very pertinaciously; but the beauty, and almost royal character of their plumage, makes ample amends for any inconvenience of this kind. See Heron.

ARDISIA (Swartz). A genus containing twenty-three species of tropical plants chiefly shrubs. Linnæan class and order *Pentandria Monogynia;* natural order *Myrsineæ.* Generic character: calyx five-cleft; corolla, salver-shaped; tube short, segments of the limb spreading and a little reflexed; stamens awl-shaped, inserted in the tube of the corolla: anthers, lance-shaped, connivent; style awl-shaped with a simple stigma; fruit a one-seeded berry. As ornamental plants they deserve a place in stove collections; yielding frequently cymes of showy red or white flowers.

ARDUINA (Linnæus). A single plant and evergreen shrub, introduced from the Cape of Good Hope, and named after Pietro Andruina of Padua, Linnæan class and order *Pentandria Monogynia;* natural order *Apocyneæ.* Generic character: calyx, five-parted, persisting; corolla, somewhat funnel-shaped, limb five-cleft; stamens included; style bifid; fruit a two-seeded berry. This is a beautiful stove plant, somewhat like box, propagated by cuttings under a hand-glass.

ARECA (Linnæus). A family consisting of ten species of palms, common in the East Indies. In the Linnæan system it is placed in *Monœcia Monadelphia*, and in the natural order *Palmæ*. Generic character: flowers seated closely on the spadix, upper ones male, lower ones female; spatha, double, membranous; calyx, three-clefted; corolla three-petaled; stigmas sitting; fruit a fibrous one-seeded drupe; albumen chewable. The areca nut is a necessary of life in India; being chewed with a leaf of the pepper betel, qualified by a little chunam (lime). Its use promotes saliva, exhilarates the nerves, gives a fine colour to the lips, and sweetens the breath. It is universally used, and never omitted to be presented as a sign of welcome at entertainments. The tender heart leaves are sometimes used like those of the cabbage.

ARENARIA—Sanderling. A genus of birds, also described under the name *Calidris*. In their characters they are tolerably distinct, and hold a middle place between the sandpipers and snipes, without having the characters of either. The form of the body resembles that of the sandpipers, though still more slightly made than these birds; the bill, again, has considerable resemblance to the bills of the snipes, only it is shorter in proportion. It is compressed laterally in the basal part, and depressed or flattened towards the tip, where it ends bluntly, but without any nail or other hardened extremity. It is flexible throughout its length, and, as there is reason to believe, sensitive; and therefore the probability is, that the birds find their food by boring into the sand close to the line of the tide, which they follow during the greater part of the year in small flocks, and with shrill and wailing cries. The feet are feeble, and entirely destitute of hind toes, but the birds are powerful on the wing. There is only one British species; but as some points in its history are a little ambiguous, we must refer to the article SANDERLING.

ARETHUSA (Linnæus). A genus of two species, tuberous-rooted herbs, natives of foreign countries. Linnæan class and order *Gynandria Monandria;* natural order, *Orchideæ*. Generic character: sepals five; helmeted, cohering at the base, swelling during growth; labellum united to the base of the column, concave, crested with interior lines; column long-jointed, linear, dilated at top, membranous, somewhat lobed; anthers terminal, without being latticed. These, like almost all the genera of the order, are interesting objects of floral elegance and fine colour. The only drawback on the possession of them is their difficult culture, which is accomplished by planting them in loose wet peaty soil, keeping them in a frame well exposed to the sun.

ARGEMONE (Tournefort). Flower-border annuals, natives of Mexico, and in class and order *Polyandria Monogynia;* natural order *Papaveraceæ*. Generic characters: calyx of two or three sepals, each sharp pointed, deciduous; corolla of four or six petals; stamens below the germen; anthers oblong, two-celled; style or stigma, headed, lobed, persisting; capsule of one cell, opening at top; placenta like a thread, the apex vaulted; stigma cohering and persisting; seeds round and rough with furrows. This genus is very nearly allied to the poppy, flowers as showy, and equally fleeting.

ARGENTINA—Argentine. A genus of *malacopterygeous*, or soft-finned fishes, belonging to the salmon family, and having many of the characters, both external and internal, of the sea trout. It has the same silvery and glistening appearance in the scales as these fishes, and that lustre in them readily distinguishes them from those which inhabit the fresh water. It is remakable that this appearance, even in the salmon, which is a native of the fresh water, is acquired only in the sea, and that it fades during the annual excursions of those fishes up the rivers. So completely, indeed, has the silvery lustre, and even the scales in which it appears, vanished by the time that the spawn is wholly deposited, that salmon are then popularly known by the name of "black fish." In the purchase of salmon, the lustre of the scales is thus a good rule for those who are not otherwise acquainted with the qualities of the fish. A lustreless fish is at all events poor and bad, and if very lustreless it is even unwholesome. On the other hand, if the silvery lustre is brilliant, the fish may be depended on as both wholesome and excellent.

The air-bladders of most fishes have this silvery lustre, but it is more remarkable in the argentine than in any other species; so much so that these vessels in the above genus of fishes are more prized by the manufacturers of artificial pearls than any other substance which they employ. This lustrous substance gives the pearly play of colour, and the isinglass of the vessels form so good a cement, that pearls thus prepared, in substance, and not mere coated glass bubbles as the inferior ones are, are with great difficulty distinguished from real ones.

The argentine has the mouth small, compressed horizontally, and without any teeth in the jaws; but the tongue is furnished with pretty strong recurved teeth, and there is a transverse row of the same on the palate. The gill-flap contains six rays. There are two dorsal fins, the second of which is small and fleshy, without any rays. The stomach is internally black.

There is but one known species, an inhabitant of the Mediterranean, though there are many other fishes which closely resemble it in a variety of their characters. Its food is not very well known; but from the smallness of the mouth, and the absence of teeth in the jaws, it is probable that it feeds on small, soft, and naked marine animals. Its flesh is wholesome, though a little dry and insipid.

ARGONAUTA. (Linnæus, Lamarck). This interesting and elegant shell is generally well known to collectors by its trivial name of the Paper Nautilus; some authors indeed have suggested the propriety of calling it the *Argo nauta papyracea*, as being more descriptive of its delicate paper-like structure; but as this shell was known and described with considerable accuracy by Aristotle, Pliny, and other early writers on natural history, the present name should be preserved, and with the greater reason, as it was given with a classical allusion to the celebrated expedition of Jason in the ship Argo, to recover the golden fleece; in which all those who accompanied him were called Argonauts, and to whom the art of navigation is poetically described as having been pointed out, in the skilful management exhibited by the instinctive little sailor, inhabiting the Argonauta, while steering its frail bark through ocean's trackless paths.

> "For thus to man the voice of nature spake,
> Go, from the creatures thy instruction take,
> Learn of the little Nautilus to sail,
> Spread the thin oar, and catch the driving gale."—Pope.

In fine calm weather when the bosom of the sea is unruffled, the Argonauta is said to have been observed gently rising with the keel of the shell turned upwards, in order, it may be supposed, to present less opposition in its ascent through the water; this may be mechanically effected by the animal ejecting a portion of the water contained in its shell, thereby rendering it specifically more buoyant; but what peculiar organisation enables it either to rise to the surface, or sink into the depths of the ocean, cannot yet be satisfactorily explained. When it has reached the surface, it gradually assumes its sailing position, extending three tentacular appendages, which passing over the thickened auriform notch on either side of the shell, serve as so many oars, while in the centre of these, two spoon-shaped membranes are elevated, acting as sails, to catch the passing breeze; and thus this pretty boat is propelled and guided on its way through the azure main. On the approach of any sudden danger, or of tempestuous weather, the little mariner lowers the sails and withdrawing the oars, retires into the hull of its vessel, again sinking to the bottom of the ocean, undismayed by the perils of the deep, a circumstance elegantly alluded to by Byron, when describing the dangerous vicissitudes of a sailor's life.

> "The tender Nautilus, who steers his prow,
> The sea-born sailor of this shell canoe;
> The ocean Mab, the fairy of the sea,
> Seems far less fragile, and alas! more free!
> He, when the lightning-wing'd tornados sweep
> The surf, is safe, his post is in the deep,
> And triumphs o'er the armadas of mankind,
> Which shake the world, yet crumble in the wind."

Lamarck placed this mollusk in his second order, *Cephalopoda*. Cuvier also considers it properly so classed; but De Blainville, in his system of Malacology, does not admit that the animal belongs naturally to the shell in which it has been constantly found, considering it a parasite, he says the animal of the genus Argonauta is altogether unknown, but a consideration of the form of the shell, induces him to suppose it closely allied to the *Spiratella* and *Atalanota;* he has therefore placed it following these genera, forming the family *Pteropoda*, of the fifth order, *Nucleobranchiata;* second class *Paracephalophora*.

This interesting little animal has perhaps furnished more matter of dispute, a greater diversity of opinion, and, in some instances, more ill-will among naturalists than any other subject in the whole range of animated nature; and during a period of more than two thousand years, the question is not yet decided, nor apparently nearer being so, whether the animal invariably found in the Argonauta is the architect of that shell, or merely a pirate. As it does not however form any part of the object of this work, to take up the dispute on either side; and as we do not arrogate to ourselves the power of elucidating a matter so involved in doubt, we shall only for our part say, that the animal never having been found in any part of the world living *free* from the shell, though certainly not conclusive, is good presumptive, evidence of its being "the lawful owner of its fairy bark." Whether it should be considered one of the genus Ocythoë, or, as others imagine, Octopanus, it appears to us quite certain, that none but a similarly organised animal could have constructed such a dwelling; an opinion we deem to some extent confirmed by an examination of the mollusk, whose smooth thickened auriform processes on either side of the aperture, appear to serve as points d'appui for the tentacular members said to act as oars, and they are therefore wisely so constructed, to prevent the laceration that might otherwise ensue from the constant action of rowing, had those parts been formed thin and cutting, as is the case with the other portion of the aperture.

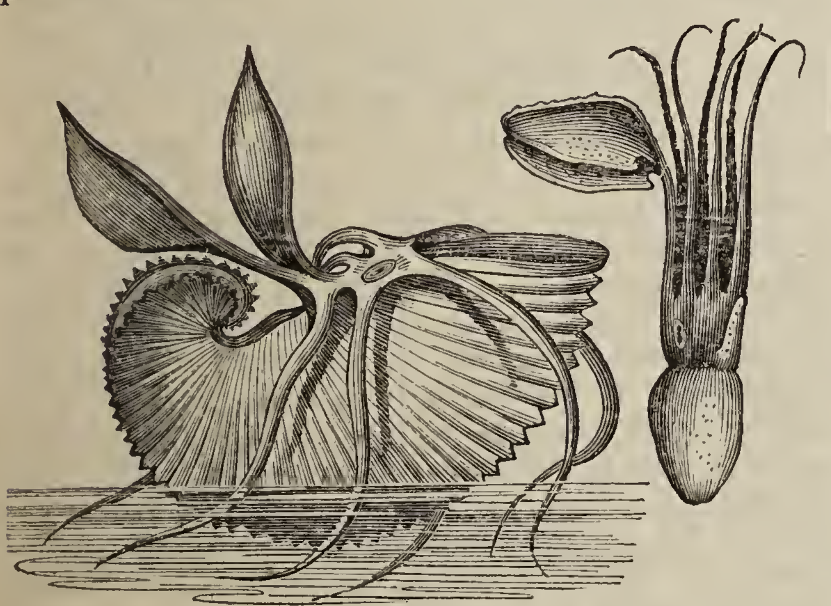
Several scientific naturalists of the present day have published opinions on this subject; to some of which we will briefly allude, leaving our readers to draw their own conclusions. Dr. Leach, in a Memoir published in the Philosophical Transactions, June 5th, 1817, states, that "Pliny, Androvandus, Lister, Rumphius, D'Argenville, Bruguière, Bosc, and Shaw, have described a species of this genus, that is often found in the *Argonauta argo* (common paper nautilus), and which they have regarded as its animal, since no other inhabitant has been observed in it.

"Sir Joseph Banks and some other naturalists have always entertained a contrary opinion, believing it to be no more than a parasitical inhabitant of the argonaut's shell; and Rafinesque (whose situation on the shores of the Mediterranean has afforded him ample opportunities of studying this animal, and of observing its habits), has regarded it as a peculiar genus, allied to the polypus of Aristotle. (*Sepia octopodia* of Linnæus.) De Blainville, ten months since, said 'animal unknown;' and he has lately informed me that he has written a long dissertation to prove that the ocythoë of Rafinesque does not belong to the shell in which it is found, but," continues Dr. Leach, "Mr. John Cranch, zoologist to the unfortunate Congo expedition, has cleared from my mind any doubts on the subject. Having taken several specimens of a new species of *ocythoë*, which were swimming in a small *argonauta*, on the surface of the sea, in the Gulf of Guinea."

W. J. Broderip, Esq., F.R.S., has published a paper on the argonaut in the fourth volume of the Zoological Journal, in which he says, "Is it not strange that it should now be a question whether the animal usually found in the shell popularly called the paper nautilus is the lawful owner of its fairy bark?

"From the time of Aristotle, the delicacy of the bark and the habits of its sailor have afforded a subject to every observer; and we have in addition to the descriptions, a succession of figures by Aldrovandus and others, which though most of them afford proofs of a very lively imagination on the part of the designers, are still evidently figures of a cephalopod, which would in the age of Linnæus have been ranged under the genus *Sepia*, if it had been taken swimming at large and free from any shell. It is curious to observe how assertion upon assertion at last accumulates into something that is taken for positive proof, till at last we have descriptions apparently the result of actual observations. De Ferussac in his "*Notice sur l'Animal du Genre Argonaute*," arguing for the legitimate title of the animal to the shell in which it is found, is of opinion that it is *no parasite*, and in opposition to the opinion of De Blainville considers the question put to rest. Risso who appears to be of the same opinion with De Ferussac, says *Je n'ai jamais vu retirer cet animal de la mer sans être toujours muni de coquille*." Mr. Broderip concludes, by saying "There is not, perhaps, sufficient evidence to convict the subject of our memoir of piracy, but there is quite enough to make us strongly doubt the assertion, that he is his own industrious shipwright."

J. E. Gray, Esq., F.R.S., has also published a paper in the Zoological Journal, from which the following observations are abridged, in illustration of some observations on the disputed question of the molluscous animal (*Ocythoë*), found in the shells of the genus Argonauta, being a parasite or not. He states that he had lately examined ten specimens, four of them referable to *Ocythoë Cranchii*, and the remainder to *Ocythoë antiquorum*, there being but little, however, to distinguish them except their size. All these specimens, as well as those which have been figured, were females, and had eggs enclosed in the hinder part of the shell, in the cavity which is uniformly found behind the body of the animal. Only one or two of these individuals had their bodies marked with the ridges of the shell, the impressions of which were, however, mostly observable upon the arms. The animals all appeared to be retained in the shells by the inflection of the anterior pair of arms. He adds, that he had also lately seen several specimens preserved without shells, and having their bodies shaped exactly like that of the common *Octopus*, without the slightest appearance of having been enclosed in a shell. From these facts Mr. Gray is inclined to regard it as probable that the *Ocythoë* is only parasitic in the shell of the argonauta, and that the shells are only resorted to by females during the breeding season for the protection of their eggs, the chief purpose of the dilated portion of the anterior arms being to retain the animal in the shell. He also states, that he is not aware that any author had distinctly asserted from his own observation, that these parts are expanded into the form of sails before the wind, a service they seem incapable of performing except in poetic fiction.



A. argo.

The genus is divided into three species by Lamarck, the shell of the first, *A. argo*, here figured, has its keel much narrower than the others, and the pointed tuberculations on either side of it very sharp; the sides of the shell are transversely striated, with wrinkles proceeding longitudinally from the recurved spire: the second species, *A. tuberculosa*, is more convex at the sides, having nodulous elevations, the keel much broader, and the points on either side of it more obtuse; the third species, *A. nitida*, is a much smaller shell than the *A. tuberculosa*, and has its aperture very much dilated in proportion to its size: in general appearance it however resembles the latter.

One of the species inhabits the Mediterranean, and the two others the Indian and African seas.

The elegant symmetry and the delicate structure of this mollusk, combined with the doubtful character and habits of its inhabitant, will always render it an object of interest, not only to conchologists, but to all persons who love to look from "nature up to nature's God," and humbly trace the infinite wisdom displayed in all *His* works.

We cannot close this article without briefly adverting to the admirable memoir on this part of the animal kingdom by Mr. Owen; which, for elaborate research and anatomical knowledge, stands superior to any other work on the subject.

ARGUS, or ARGUS PHEASANT (*Phasianus Argus*), a large, beautiful, and very singular species of pheasant, found native in the south-east of Asia, more especially in Sumatra and some of the other islands. Some naturalists have made it the type of a new genus (*Argus*), to include the superb pheasant of China, the existence of which is only known from Chinese paintings, and is on that account a little doubtful. One circumstance would, however, lead us to believe that a bird, which the Chinese represent so often, and always with the same characters, has a real existence in the country. That circumstance is this: the *Camellia japonica*, frequently represented in Chinese paintings, was long regarded as a merely imaginary plant; and yet it is now, perhaps, the leading beauty in the British garden. The same may be the case with the superb pheasant; but we must in the mean time confine ourselves to the argus. This bird, except its superior size, and the singular enlargement of some of its feathers, hereafter to be noticed, is a true pheasant. The bill is as long as the head, compressed, the upper mandible curved, and slightly hooked at the tip. The nostrils are about the middle of the upper mandible, lateral, and half closed by membrane. The tarsi are slender and without any spurs. The three anterior toes are partially united by membrane, and they have *rasorial* or scraping nails like the other gallinæ. The head, cheeks, and part of the neck, are destitute of feathers. The tail is elevated, divided into two compressed planes of six feathers each, and having the two middle feathers much longer than the rest. The wings are singular in their structure. They are short and round, very short, in fact, in proportion to the size of the birds; but in proportion as the primary quills are short, the secondaries are long and broad, being in the male not less than two feet and a half in length. Those produced feathers are thickly studded over with eye spots, which have a very brilliant appearance, and on account of which the bird has been called argus. When the bird displays himself, for it is in the male that the greater splendour appears, the feathers of the tail are spread fan-shape, with the two long feathers in the middle rising high over the rest. The produced secondaries glittering with their multitude of eyes, bear against the lower and lateral parts of the tail, and rising high over these, give the whole display the form of a coronal plume with three points. The colours are beyond description beautiful, as there is no language containing names for a tenth part of the tints. Every colour is there in the perfection of its beauty; and yet the contrasts are so sweetly delicate, that there is not the slightest expression of gaudiness about the whole bird. As is the case among all gallinaceous birds, the female is much less showy than the male, has the secondaries less produced, and without the eyes, which give so much liveliness to the other.

One peculiarity of the colouring of this splendid bird is, that the whole effect is produced with scarcely any assistance from metallic lustres and reflections.

Gigantic Argus.

These birds are very large, far exceeding in size any of the other known pheasants. They are birds of the mountains, and as such may probably be met with along the heights of the eastern peninsula as far as China; though hitherto their localities have not been much examined, and but little is known of them in a state of nature. It is understood, however, that their habits are similar to those of the other pheasants, only that they do not perch in trees—at least not habitually. When marching about on his native pastures, under the brilliant sky, and with the incense-loaded breeze, which plays with perpetual health on the mountain tops of that paradise of the world, the argus-pheasant must be a splendid bird, probably the most splendid of the whole of the feathered race; and as there is heat and light to bring out and display his colours with the utmost perfection, and an atmosphere to stimulate to the utmost, yet without fatigue or exhaustion, he must be seen to greater advantage than any tenant of the woods or of more confined places. He stands nearly five feet in height, and those masses of feathers which are studded with eyes, each present a beam of glories two feet and a half long, and at least nine inches in breadth. The carriage of the head, too, is majestic; and during the breeding season, all the naked skin on the head and throat is a fine pure red, contrasting beautifully with the bright golden yellow of the irides, and the paler yellow of the bill. The bird seems rare; but with proper attention it might, perhaps, be introduced, and made to breed in this country.

ARGYREIOSUS (so named from its silvery colour). A genus of *Acanthopterygous*, or spinous-finned fishes, belonging to the mackerel, and, like the rest of that family, a surface fish, but differing greatly in form and in the structure of its fins. By Linnæus and his followers it was included in the genus *Zeus*, the type of which is the celebrated John dorée, a genus which with them was not a little confused. There is only one known species, which is the *Zeus vomer* of Linnæus. It is a fish of the clear and deep waters on bold shores; and it is not a little singular that the two localities in which it is most abundant, if not the only ones in which it is found, are the shores of Norway and those of Brazil. The body of this fish is greatly compressed and enlarged in the vertical diameter, so that the profile is very much elevated. The first dorsal fin is long, and the second of considerable length, and some of the rays of both are prolonged into filaments. The ventral fins are also very much produced, and the fish can extend them laterally so as to present a sort of broad base, and thereby steady its thin and elevated body. Notwithstanding its ungainly form, it gets through the water with considerable rapidity, but its food and habits generally are little known.

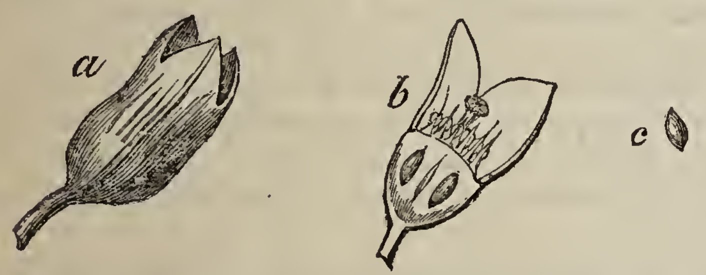
ARISTEA (Linnæus). A family containing five species of handsome blue flowering herbs, natives of the Cape of Good Hope, belonging to the Linnæan class and order *Triandria Monogynia;* natural order *Irideæ.* Generic character: spathas bundled, chaffy, rarely green; corolla of six regular plane petals, with a short tube; stamens erect, fixed to the germen; style cylindrical; stigma in three heads or flattish; capsule prismatical, seeds flat. They are green-house plants.

ARISTOLOCHIÆ—The Birthwort tribe. A natural order of plants containing only two or three genera, and placed upon the limits of the *Monocotyledons* and *Dicotyledons.* The order is nearly allied to the *Cytineæ.* Its essential characters are: flowers hermaphrodite; calyx adherent with the ovary, and divided into three segments; stamens varying from six to ten, sometimes free and distinct, at other times adhering with the style and stigma; ovary three to six-celled; style short; stigma divided; fruit dry or succulent, three to six-celled, many-seeded. Herbaceous plants or shrubs, very abundant in the tropical regions of America. Some of them are climbing. Their general properties are bitter, tonic, and stimulating; these qualities reside chiefly in the roots. None of the aristolochiæ are poisonous. The chief genera in the order are *aristolochia* and *asarum.*

The *Aristolochia clematis, rotunda* and *longa,* are natives of Europe, and have been celebrated from remote antiquity for their stimulating effects on the female constitution. The first of these species is frequently found among the ruins of nunneries in England, and is known by the name of common birthwort. It was formerly recommended in gout, and is one of the ingredients of the Portland powder, so celebrated for the cure of that disease. The other species have been used in ague and catarrh. The root of the *Aristolochia serpentaria,* Virginian snake-root, is an article of the materia medica. It has an aromatic smell like valerian, and a warm pungent taste, somewhat resembling camphor: with alcohol it gives a light green tincture. It is heating and stimulating, owing to the essential oil which it contains, and its action is chiefly on the skin and kidneys. It is used in ague and typhus fever.

The mode in which the seeds of the *Aristolochia clematis,* and of several other species of the genus, are perfected, is singular, and deserves to be noticed. The stamens and pistils are excluded from the influence of the air by being confined in the globular base of the flower, and the stigma being placed above the anthers it is scarcely possible for the pollen to be distributed upon it by the usual means. This, however, is accomplished by means of the *Tipula pennicornis,* a small insect which enters the superior tubular part of the flower, and gets into the lower portion where the stamens and pistils are situated. The tubular part is lined with a number of fine hairs pointing downwards, which allow the insect to enter easily, but completely prevent its return. In these circumstances it moves about in the little chamber, and becomes covered with the pollen, which it thus scatters over the stigma; the flower afterwards withers, and the insect escapes. The plant, however, rarely bears seed in this country. An American species, the *Aristolochia sipho*, which flowers abundantly, probably from want of an insect of this kind, never bears seed.

The leaves of the *Asarum Europæum*, or *Asarabacca*, are officinal in the British pharmacopœias. This plant is indigenous in the north of England, but is not found in Scotland. The roots are brought from the Levant, and are also used medicinally. They are bitter and acrid, have a disagreeable nauseous odour, and possess powerful emetic and purgative properties in the recent state. The powdered leaves are used as an herb snuff to promote sneezing, in cases of drowsiness, headach, sore eyes, and palsy. The root of the *Asarum Canadense* has an aromatic flavour, more agreeable than that of the Virginian snake-root, and is used in America as a warm stimulant to promote perspiration. By the country people it is used instead of ginger, and hence has received the name of wild ginger.



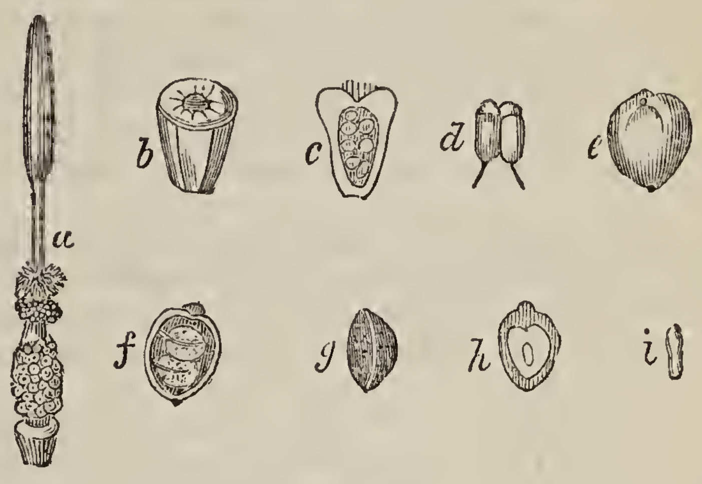
Asarum Europæum. *a*, Flower; *b*, section of the same; *c*, seed.

In consequence of the genus *Asarum* being included in this order, it has sometimes received the name of *Asarineæ*.

ARISTOTELIA (Linnæus). A South American evergreen shrub, named in honour of the Greek philosopher Aristotle, belonging to the Linnæan class and order *Dodecandria Monogynia*, natural order *Homalineæ*. Generic character: calyx five-cleft; corolla five-egged petals, equal to the calyx, inserted on the receptacle; stamens below the seed-vessel; filaments short; anthers linear; style like a thread, protruding; stigma, tripid, reflexed; berry round, three-celled. This shrub is tolerably hardy, growing freely in sheltered situations, and the berries are eatable, of a purple or black colour, and slightly acid. In Chile the inhabitants make a wine from it which is administered in fevers, and which is supposed to cure the plague. It is propagated by layers and cuttings.

AROIDEÆ.—The Arum tribe. A natural family of monocotyledonous plants, the two hundred and fourth order of the system of Jussieu (*Loudon*), containing about twenty genera, and upwards of a hundred and twenty species. The plants included in this order are generally herbaceous and stemless, and are frequently furnished with broad fleshy leaves, somewhat resembling those of dicotyledonous plants. They grow in shady moist places, are found abundantly in tropical climates, though rarely in those which are temperate. In the tropics the aroideæ occasionally become arborescent, and sometimes throw out aërial roots by which they become attached to other trees. Some of the plants of this order, as, for instance, several species of the genus *Pothos*, are truly parasitic. In America some of the aroideæ are found at an elevation of upwards of 8000 feet above the level of the sea.

The essential characters of the family are:—flowers sometimes hermaphrodite, sometimes unisexual, numerous, sessile, growing on a spadix which is sometimes enclosed in a coloured spatha or sheath; the perianth is often wanting; when present, it consists of four or six segments. In the male flowers, the stamens vary in number, and are very short; the anthers are subsessile, ovate and turned outward. In the females, the ovary is superior, and many-seeded; stigma sessile. The fruit is simple, and either succulent or capsular. Seeds vary in number. The order has been divided into three sections; the true *Aroideæ*, the *Dracuntiaceæ*, and the *Arontiaceæ*.



Arum Maculatum. *a*, The spadix, with the male and female organs, and nectaries in their relative situations; *b*, ovary; *c*, the same in section; *d*, anther; *e*, fruit ripe; *f*, the same in section; *g*, seed; *h*, the same in section; *i*, embryo.

In the aroideæ, as in most monocotyledonous orders, the roots are the chief objects of interest, whether we regard them in a medical or economical point of view. In the fresh state they are acrid and stimulating, sometimes possessing purgative and even poisonous qualities. When dried, subjected to heat, or macerated, they lose their acrimony and become mild and nutritive. A good illustration of this may be found in the case of the *Arum maculatum*, the cuckoo-pint or wake-robin, a plant which is pretty common in England, although rare in Scotland and Ireland, and which is well known by its spotted arrow-shaped leaves, and its fine red berries, which remain during the winter. The root of this plant, when fresh, is very acrid and pungent, causing swelling of the tongue, salivation, and a burning sensation in the mouth and throat; but when boiled or macerated it is wholly deprived of its acrimony and may be used as an article of food. It is so employed by the inhabitants of Weymouth, and the island of Portland, and is made by them to yield an amylaceous substance, which is sold in London under the name of Portland sago, and is an excellent substitute for bread-flour. In Sclavonia, after being washed, boiled, and dried, it is preserved as food during the winter.

The plant is retained in the pharmacopœias. The fresh root, when mixed with gum arabic or spermaceti, so as to prevent it exerting its pungency on the mouth, may be administered as a very powerful purgative, in doses of ten or twenty grains. The dried root is quite inert, and the French prepare from it a harmless cosmetic called cypress powder.

The roots of the *Arum colocasia* and *esculentum*, the Indian kale of the West Indies, the tairo of the South Sea Islanders, when roasted or boiled, are deprived of their acrimony and become agreeable and important articles of food. The leaves of the first-mentioned species, when cultivated and duly prepared, are employed as a potherb. The root of the *Arum campanalatum*, which often weighs from four to eight pounds, is cultivated as the potato is in this country, and as the yams in the West Indies. It is said that milk in which the root of the *Arum triphyllum* has been boiled is useful in consumptive cases.

The different species of *Caladium*, a genus belonging to this family, invest the trees in the tropical forests, and from their colour and form constitute a striking feature among the plants of those regions. Some of them are stemless, while others have long climbing stems from which thick roots arise. They all furnish an acrid juice. The *Caladium seguinum* has the property, when chewed, of causing the tongue to swell so as to impede speech. On this account it is called in the West Indies dumb-cane. The *Caladium fragrantissimum*, a native of Demerara, diffuses in its recent state a most powerful and delicious odour.

The *Calla Ethiopica*, a plant included under the aroideæ, is commonly cultivated in green-houses and drawing-rooms on account of the beauty of its flower. The *Calla palustris* is found in the northern parts of Europe, and inhabits the deep stagnant and frozen marshes of Lapland. The fresh leaves of the *Calla pertusa* are used in Demerara as blisters and rubefacients for the cure of dropsy. The root of the *Dracontium polyphyllum* possesses antispasmodic virtues. The root and seeds of the *Symplocarpus fœtidus*, skunk weed or skunk cabbage, a plant found in Canada, and very abundant in the meadows and swamps of the United States, are used in asthma, catarrh, and chronic coughs. The flowers of this plant appear before the leaves, and are so unlike a vegetable production that a person at first sight would take them for something artificial, or for a shell of the cypræa tribe. Their very fetid smell, however, on a near approach, soon dissipates the delusion.

The *Acorus calamus*, common sweet flag, is another interesting plant belonging to the aroideæ. This plant is found in watery places in the south-eastern counties of England. It has an aromatic root or rhizoma, known in commerce under the name of *Calamus aromaticus*. It is stimulant, carminative, and stomachic, and is frequently administered in intermittent fevers and in gout. After being blanched it is mixed with sugar and used in Constantinople as a preventive against epidemic diseases. From its agreeable odour the plant is used for garlands, and is strewed on the floor of the cathedral at Norwich on festival days.

Some of the plants belonging to this order possess a peculiar property of evolving heat at a certain period of their growth. This has been particularly observed in the *Arum maculatum* and *italicum* at the time when the sheath opens. The heat has been observed to be 7° above the temperature of the surrounding air. The rise in temperature begins at three or four o'clock in the afternoon, attains its maximum at six or eight, and finally ceases at ten or eleven at night. During the evolution of heat the spadix becomes of a black colour.

ARMADILLO. The name given by the Spaniards to a very singular genus of mammalia, which are found only in South America, and chiefly in the woods or on the plains of Paraguay, or otherwise in the great valley of La Plata. They are animals of many names, as well as many peculiarities. The name armadillo, which in England has become the common name of the genus, means "clad in armour." The name *encuberto*, by which they are known to the Portuguese, has nearly the same meaning; and they apply it indiscriminately to the whole genus, though in Europe it is often used as denoting only one particular species. *Tatou* is the name given to them by the natives of Brazil, and has been adopted by D'Azzara, the Spanish naturalist, to whom we are indebted for the best account of them in their native localities. The generic name bestowed upon them by Linnæus, and still retained by the majority of systematic writers, is *dasypus* (hairy foot), which is one of the old Greek names for the hare or rabbit, and certainly as little descriptive of the armadillos as can well be imagined; but it has the sanction of custom, and therefore it is not, perhaps, worth while to change it for a better one, the more so that the characters of the animals are so striking, that there is no danger of confounding them with any others. *Dasypus* may also mean "thick foot," or "foot closely put together;" but though that is true of the armadillos, it is not more descriptive of them than of many other animals.

Their most obvious and striking characteristic is the armour, or shield, or shell, or whatever else it may be called, with which the upper part of their bodies is covered, and from which they get the Spanish name that has been adopted as their English one. This covering, taken all together, has a very considerable resemblance to plate armour. It consists of a great number of transverse bands or segments, marked with a succession of studs. These bands are, in some instances, that is, on some parts of the body, completely united into broad bucklers, each consisting of a single piece, and moveable only as a whole, whatever may be the apparent number of bands of which it is made up. Of these broad pieces there are three; the first covering the upper part of the head, as a sort of helmet; the second, which is much larger, covering the neck, shoulders, and more or less of the back; and the third covering the croup from the loins to the tail: between the second and third of these there is a variable number of smaller pieces, united by skin but admitting of very little motion. The number of these intermediate and slightly moveable bands, has been popularly made the foundation of specific distinctions; but it is by no means well adapted for such a purpose, as the number often varies in the same species, and is often the same in different species.

No complete set of observations on the progress of this curious covering during its growth has been made; and therefore it is impossible to say that each transverse band both of the larger and of the intermediate plates is formed separately, with skin intermediate until it is full grown. But this is probable, inasmuch as the anchylosis or immoveable adhesion of these bands together, does not always take place at the same age in the same species; and it is probable, though even that has not been carefully observed, that the skin between the several plates, or the joints of the armour, as we might say, stiffen and approximate to anchyloses as the animal advances in age.

The plate on the head, or helmet, is much narrower than those on the body. It commences not at, but generally near, the muzzle, and passes towards the occiput in such a manner as partially to shadow the eyes from perpendicular light, but not to cover either them or the ears. It is composed of a number of tuberculated pieces, but so closely united together as to form one immoveable covering of very considerable firmness and strength. From the edges of this there generally proceed two rows of hard tubercles, which pass under the eyes, become gradually smaller, and terminate on the cheeks.

The plate or buckler on the neck and shoulders is much larger, and descends laterally so much as to conceal the greater part of the fore legs except the feet.

The intermediate plates and the plate on the crupper descend also far down laterally, so that the last in a great measure conceals the hind legs; and thus the whole animal appears "thatched," so to express it, with transverse bands of shell or crust, which are so thick, firm and hard as to be a perfect defence against the attacks of almost any animal.

The tail also has its armour, which consists of a greater or smaller number of rings, not perhaps absolutely united into a solid, but still usually admitting of little or no motion in that organ.

From this external covering of the armadillo it is the least flexible of all the mammalia; and when it turns, it turns like a block upon legs, without any perceptible bending of the body even at the junctions of the intermediate plates. The head is capable of little elevation, so that, in a lateral or upward direction, the animal is less capable of motion than a tortoise. In the remaining direction, or downwards, the motion is more free, as some species can roll themselves partially, and one of them completely into a ball.

Though the uses of this most singular covering, in the economy of these curious animals, are little understood, yet they must be important, as the organisation, especially that of the spinal column, has reference to it. With respect to their internal structure, however, it is very difficult to speak generally, as there are differences in the species, sufficient almost to call for divisions into different genera; and all the species have not been dissected with equal care. The point of resistance to the general action of the spine, and indeed to that of the whole animal, appears to be the sacral or hinder extremity. The whole thence to the muzzle pushes forward as a stiff and nearly inflexible column, sustained partly on the spine itself, and partly by the armour.

On the frontal bone there are two elevated processes, one object of which is evidently to support the helmet or plate which covers the head; and these differ with the form of the head and relative size of the helmet in the different species. The number of vertebræ in the neck is seven, as in all mammalia; but their structure is very different from that of animals which have free motion in that part of their bodies: very remarkably different from the neck of the tortoise, which, though an animal of a different class, is very apt to occur to one's memory when examining an armadillo. The short neck of that animal has its vertebræ so articulated, as to admit of more motion within a limited compass, than perhaps any other animal structure. The neck of the armadillo is the very reverse: it has little motion in any of the joints, and some of the vertebræ, especially the third and fourth, which being the middle ones, necessarily give stiffness to the whole neck, are anchylosed or united together. In this respect the neck of those animals resembles the neck of the whale, which not admitting of lateral motion, carry the head forward with the same stiffness as if the neck were one solid bone, and yet without the danger of fracture that might result from a structure of that description. The transverse processes of the vertebræ of the neck are very long, and assist in supporting that portion of the buckler by which the neck is covered, so that the spinal structure of the neck and its exernal covering both conduce to the same end, that of giving stiffness; and there is no doubt that the buckler diminishes or destroys any strain upon the cervical spine which might tend to injure the spinal cord.

The dorsal vertebræ, which are represented as being twelve in number, are not anchylosed, but they admit of very little motion; and their spinous processes, which are much produced, are directed backwards, and bear against the buckler like props or stays. The hinder dorsal vertebræ and the lumbar ones, which are three in number, have the processes still more produced, and directed outwards and forwards, so as more completely to support and bear up the heavy armed covering of the animal at that part of the body where there are no ribs. After the spine (which generally consists of eight sacral vertebræ posterior to the lumbar ones) is past, the bones of the pelvis are so formed as to give support to the plate on the crupper. At the anterior edge of the pelvis, the *ilia* rise into two short but thick props; and at the posterior, the tuberosities of the *ischia* rise in the same manner, and by these four bony prominences the plate is completely supported.

In considering this structure, we find two results: in the first place, any pressure which is communicated to the anterior extremity of the spine, or, which is the same in effect, any resistance to the motion of the spine forwards, is so transferred to the plates of the armour, that these divide the strain, and in great part take it off that organ; secondly, from the support given by the extended processes of the posterior vertebræ, and the projecting processes of the bones of the pelvis, the posterior part of the armour is kept wide at the sides, so as not to interfere with the contents or functions of the abdomen or pelvis, the latter of which is large and wide in proportion to the size of the animals. Such is the covering of the upper part of those curious animals, and the means (at least one of the means) by which that covering is turned to account. We shall now briefly notice the appearance and covering of the under side.

The head, except the parts that have been mentioned as covered by the helmet or the hard tubercles under the eyes, is covered with skin, and so is the whole body below the armour, and the legs, with less or more of hair upon it, according to the species. There are also in some species numerous long hairs in the interstices of the plates. The skin on the under part of the body is beset with tubercles, and they get hard and indurated on the legs and feet. There are, however, none upon the soles on which the animals walk, and these are also without hair. The legs are short, and from the portion of them that is covered by the armour, they look much shorter than they really are. They are, however, very thick and strong. The feet are large and flat, and have the toes united by a membrane as far as the last phalanx. There are, in some, five on all the feet, and in others, four on the anterior ones, and five on the posterior. The nails upon these are large and strong, round on their upper surfaces, hollow on their under, and admirably adapted for digging. It would not be altogether consistent with the nature of a popular work to enter minutely into anatomical details; but we may mention generally that the system of apparatus by which the feet and toes of the armadillos are moved is peculiar, very powerful, and fitted alike for vigorous and continued action.

One of the most singular indications in the bones, and consequently in the parts which these bones support, is a resemblance to birds. This resemblance appears in the bones of the lower part of the body only, because the armour on the upper part, and those adaptations of the vertebræ and other bones which have been mentioned, preclude any resemblance in that part. The resemblance is, also, but slight, not so great as in the *Ornithorhynchus* or *Echidna* of New Holland; the one of which is an aquatic animal, and burrows in the ooze and mud, the other a land animal, and burrows in the earth; but still it shows a deviation from the ordinary structure of mammalia, which breathe by expansions and contractions of the chest. In the armadillos there is a rudiment of a furcal bone, or "merry-thought;" and the sternal portions of the ribs are completely ossified. To compensate for this want of mobility in the parietes, or walls of the thorax, and still give the animal freedom in breathing, that cavity is capacious in its dimensions, and each lung of the animal consists of three lobes. These circumstances compensate for the want of a flexible chest, as in the mammalia proper, and also for that of air cells, as in birds. The bones of the pelvis also indicate a slight approach to the structure of the winged tribes. The bones of the pubis do not remain wholly detached from each other, as in these, or in the great ant-eater, or the *Chlamyphorus*, an animal which has some external resemblance to the armadillos (see Chlamyphorus); but they are united by symphosis at their points only. In the remainder of the pelvis the resemblance to birds is still greater; the *sacrum* is very broad posteriorly, and the angles of it are completely anchylosed to the spines of the *ischia*, so that the walls of this cavity are, like those of the chest, in in a very great degree inflexible.

It may seem singular, to those who are not in the habit of tracing analogies in natural history, that animals which live great part of their time under the earth, and have coverings much more solid than the other mammalia, should be the ones which have most resemblance to those animals, the majority of which spend great part of their time in the air; but it is nevertheless true; and, as has been already hinted, they, in some parts of their skeleton, also bear some resemblance to the whales, which spend the greater part of their time in the water. These analogies in structure must be attended with analogies of use, though it is more difficult to understand these, inasmuch as it is not always possible so to analyse the functions of an animal, as to show how they accord with the different parts of its organisation. The stiffness given to the neck by the anchylosis of its central vertebræ, and to the whole spinal column, by the armour, and the bearing of the processes of the vertebræ against that, evidently enables the armadillo to push forward into the earth, so as to keep itself advanced to the full action of the claws in burrowing downwards in an oblique manner, which it does with very great rapidity; so fast indeed as almost to elude pursuit; for as it gets the body buried, it takes so powerful a hold of the earth, that the tail may be pulled away without bringing out the animal. In these cases it is probable that it holds on with the whole body, and not merely with the feet. While digging, the legs are not stretched, so that when it raises itself upon these, the body is brought into firm contact with the upper part of the burrow; and the armour holds like a screw by means of its transverse prominences. The echidna shows the same facility in burrowing, and the same power of adhering to the earth; and it probably is assisted in holding on by its spinous covering.

From the direction in which it descends, which, according to D'Azzara, (whose statements being founded on personal observations are worthy of implicit confidence), is at an angle of forty-five degrees, or exactly midway between the horizontal and the perpendicular directions, it is easy to see the advantages which the armadillo derives from the firm and bird-like structure of the chest. This steep slope of the burrow continues for about three or four feet, or double the length of the average species. It is much steeper than the slope at which loose earth stands; and, therefore, what the animal pushes upward by its action in digging, must have a constant tendency to descend upon it by the force of gravitation; and thus with the pushing of the earth upwards, and the resistance of this tendency to fall down again, there must be considerable pressure on the body of the animal. One can also see the advantage of the armour, and even of the enlarged pelvis in the performance of this operation. The armour bears against the roof and sides of the burrow, nearly as a solid piece, the whole extent of the body of the animal; and its transverse irregularities take such a hold as to form a powerful fulcrum for the digging members, while the breadth of the pelvis prevents the mould from rolling back at the sides, and pressing upon and hampering the anterior part of the animal, the part which has the hardest task to perform.

But the resemblance to birds is not confined to the bones of the under part, it can be traced in the digestive organs. Most of the species, if not all of them, are very miscellaneous in their feeding. Tuberous roots, and other farinaceous vegetable substances, worms, insects, carrion, all things, in short, that constitute what may be called an omnivorous, or, at all events, a very miscellaneous feeder, are greedily sought after by armadilloes. Their teeth are not at all adapted for mastication, as whatever may be their number and their situation in the mouth, they are slender, stand apart from each other, and in the two jaws fall into the intervals of each other when the jaws are closed, so that they do not cut tooth against tooth, in such a way as that they can either cut or bruise. The mouth is thus an instrument for the prehension or taking of the food only, and can assist little, if at all, in preparing it for the stomach. The stomach is partly of a gizzard structure, that is, its coats are thick and muscular toward the pyloric extremity, or that to which the intestinal canal is attached. This structure evidently answers two purposes: first, it prevents the food from getting into the intestines before it is properly comminuted; and secondly, the action of the muscular coat assists in the process of comminution, in the same manner, though probably not to the same extent, as the gizzard of birds. This gizzard structure has not been observed in all the species, because they have not all been dissected with the same care: but it is probable that it may vary—be less in the ones that feed most upon animal substances. Nay, it may vary in the same species, just as the stomachs of birds vary so as to adapt themselves to different kinds of food, when habituated to these exclusively. A certain degree of adaptation in the stomach in this way, is common, if not universal, among animals; and it is one of those wise provisions of nature, by which races are prevented from perishing, when, by any casualty, the supply of their natural food is reduced below the quantity which they require.

Though the head of the armadilloes varies in the different species, it may be considered as in general small, and narrow and produced at the snout. The nostrils are terminal, and the sense of smelling is understood to be very acute. The eyes are small, but perfect in their formation, and, in some of the species at least, furnished with a third eyelid or nictitating membrane. The tongue is soft, and though it is but little extensile, and cannot be projected beyond the mouth, like that of the ant-eater, it may assist in the capture of ants and other small prey, as the saliva is of a peculiarly viscid nature, and obviously better fitted for assisting in the capture of the food than in the preparation of it for the stomach. Indeed, the incapacity of masticating renders saliva unnecessary for the latter purpose. The teeth have been already noticed, they are all of the same character, and cannot be described as answering to any of the three sets of teeth in ordinary mammalia, as they have as much resemblance to the teeth of reptiles or fishes, though they differ also from these. Like these, also, some of them have teeth upon the intermaxillary bones, as well as in the jaws. It has been remarked, that they are not adapted for cutting or bruising, and they are just as unfit for tearing. Hence the animals never, even in defence of their lives, show the least disposition to bite. They do not appear to be capable of dividing any thing but a pulpy substance which has no toughness; and that may be the reason why, though they are fond of the flesh of large animals, they never attempt to eat it till it is putrid. In this respect they bear some analogy to the alligators, which always bury their larger prey till it is softened by putrefaction. But in proportion as the mouth and its furniture are ill adapted for preparing the food for the stomach, the pharynx and gullet are well fitted for conveying it to that organ, the whole swallowing apparatus being furnished with muscular coats capable of very powerful contraction. Cuvier is under a mistake in stating that their intestines are without cœcal appendages; for some of the species have two, though but of small size. One other point may be mentioned in which they have a slight resemblance to the *monotremata*, the ornithorhynchus and the echidna; and that is, that, in the female there is very little distinction between the uterus and the vagina, but both approach the form of a single canal, as in birds. The mammæ are persistent, however, four in some of the species and two in others, and they are furnished with nipples. Of course, from the form of their mouths, the young armadilloes can suck in the same manner as the young of other mammalia; whereas the *bills* of the ornithorhynchus and echidna quite disqualify them for that operation, and the females have, in consequence, no nipples, but the milk comes through the integument of the mammary glands in drops, and the young get it "as they best can," for the process of their suckling has not yet been observed.

It is understood that armadillos breed but once a year, but the brood are often more numerous than the teats of the mother; and as one cannot suppose that the surplus number are regularly produced only to perish for want of maternal nourishment, there is no doubt but what two or more must often be nursed upon one teat. That, however, is not an anomaly in nature; for though the most prolific species generally have the most numerous teats, there is no necessary connexion between them and the number of young: the cow, when she drops but a single calf, has all the four teats equally furnished with milk.

Armadillos are found only in South America, and not in the southern parts or the mountainous parts in any latitude, or in those places which are subject to inundation during the rains. Some of the species are found in Guiana, and others in the pampas to the southward of La Plata; but they are not so numerous in these, which may be considered as the limits of their geographical distribution, as they are in Upper Paraguay and the adjoining parts of Brazil. In these they are very plentiful, and, for reasons which will be pointed out by and by, their numbers are probably increasing rather than diminishing. Some of them confine themselves more to the woods (not the thick and tangled forests or the humid grounds, but the woods on dry land, which are less luxuriant and more open), and others reside more in the open plains. They chiefly live in burrows, descending at first, as already described, at an angle of forty-five degrees, till they gain a depth of about two feet and a half below the surface; they then proceed for four or five feet more without descent, or rather with a little rising, and the dwelling is at the further extremity. By this mode of descent they obtain a roof strong enough not to fall in; and the turn which it afterwards takes secures them from rain, the quantity of which that can enter by the small external opening is not, under ordinary circumstances, very great. Some of the species remain constantly in their burrows during the heat, and even the light of the day, and come abroad to feed only during the night. These species are said to be very timid in their manners. Others come abroad at all times, and are less easily alarmed. They all, however, make for their burrows when pursued; and if they find that they cannot reach those, they set about earthing themselves with great expedition. Notwithstanding the shortness of their legs, the apparent weight of their mailed covering, and its stiffness, which prevents flexure of the spine and those alternate risings of the shoulders and the crupper, which are seen in the ordinary mammalia, their progressive motion in a straight line is by no means slow, for some of them will outrun an ordinary man. They owe this rapid motion entirely to the great muscular power of their legs, and to that concentration of the action of the whole body toward the sacrum as a point of rest, which urges them forward when digging.

Their digging is not confined to the excavation of their dwellings, for they also practise it in the seeking of their food. They thus get at tuberous roots in the ground, and also at worms and other small ground animals. As the structure of their tongues is not so well calculated for the capture of ants as those of the ant-eaters, they do not devour these insects in such numbers; but they are said to exterminate them much more speedily and completely from places where they abound. They effect this by mining obliquely into the ant-hills in all directions, and especially by digging down upon those places where the chrysalids of the young ants are collected, the capture of which annoys the workers more than that of a part of their own numbers. The holes which they make are also too deep and large for being easily filled up by the ants; and as they admit water to the very lowest inhabited part of the hill, the ants are either driven out, or drowned by the first rain that falls. Indeed, the best way of destroying a large ant-hill in any country, is to lay it open by boring in the same manner as is done by the armadillos.

They also bore under or into dead carcases, commencing in the earth at some distance, and going directly to that part of the carcase which pleases their sense of smell the most. They thus continue till they, on repeated visits, eat out the whole of the interior, while the surface, which is exposed to the hot and drying atmosphere, is too hardened for their being able to make any impression upon it; and if they find the putrid interior full of maggots, these and the substance upon which they are feeding are equally welcome as a mess. They often also invade the graves of human subjects, not merely of those who die in the woods or wide plains, and have to be buried there, but in the burying-grounds, and those who are attentive to the mortal remains of their friends, protect them with stones or bricks, as a defence against the armadillos. Unless, however, the place of sepulture is so secured in the bottom, as well as at the sides and on the top, the security is not perfect, as the animals get below, and mine upwards till they come at the body.

It is said that the males, and even the females, evince that desire to devour the young in the early stage, which is sometimes shown by pigs and other animals; and as it may sometimes happen that the female, immediately after littering, has not access to other food, one part of the brood may in this way be sacrificed for the preservation of the remainder; and, if so, the disproportion of the number of young produced above that of the teats of the mother may be in so far accounted for.

They multiply abundantly, however, and when they are so far grown as to be able to take care of themselves, they have few enemies. The shields are proof against the teeth of the puma, or any other of the few beasts of prey that are found in the locality of the armadillos; and, as the feline race never scrape to any extent in the earth, as that would damage their retractile claws, the armadillos soon remove all that part of their bodies upon which teeth or claws would make any impression out of the reach of such foes. The vultures are the rivals of armadillos in the matter of carrion; but the vultures are not much disposed to kill if they can otherwise find food, and while feeding they are too much occupied for interfering with any other creature, even though it is at work close by upon the same subject. Besides, the nocturnal ones are not abroad at those times when the vultures are feeding; for vultures are day feeders; and, therefore, though much is usually said about the acuteness of their sense of smell, it is probable that they depend much more on sight in the finding of their food. Preyers by scent are usually nocturnal, or at least twilight feeders in a state of nature; and therefore the allegations about the sense of smell in the vulture, which have given scope to much ornate expatiation on the part of those who know not very well what they say, demand direct proof before they can be implicitly admitted.

Having thus few enemies, and pastures more ample than almost any other race of land animals that could be named, the armadillos are very abundant, and it is probable that the colonisation by Europeans has tended very considerably to increase their numbers. They are much hunted, and many of them are captured for food, as, when roasted in the shell, some species are reckoned among the most delicious *bonnes bouches* in the country. But still they in some respects resemble *cultivated* animals, of which the numbers are contrived to be increased in proportion to the demand that there is for them. Neither the Spaniards nor the Portuguese, indeed, keep them in a domestic state, excepting a few for curiosity, though it appears that they could easily be domesticated, at least as much so as warren rabbits are, in any climate and soil suitable to their habits. But their flesh, like that of almost all animals, is probably the more racy when they roam in free nature, so that they have plenty of food; and they are so easily captured by flooding or smoking them out of their burrows, that the hunting of them is not a matter of chance, but quite as certain as that of hares or pheasants in a well-stocked preserve. And the colonists, though not intentionally, have supplied them with an abundance of food, and of food much to their liking, to which there could have been nothing comparable previous to the settlement of the Europeans in the country. The cattle which the colonists introduced have multiplied to innumerable herds in those wide and fertile plains; and the slaughter of them for the skins only is largely practised as a regular trade. These cattle, too, appear to have become so numerous, that there is no danger of exterminating them, or even permanently diminishing their numbers, as those which are killed are perhaps even more than replaced by the annual increase. When they are killed for their skins the carcases are left upon the spot, and thus there are thousands all over the country, which, though the sun dries them on the outside, every one becomes armadillos' food in the interior. Into these the mailed fellows burrow, and there wanton in a plenitude of luxury, which must have been quite unknown to them when there were no cattle in the country. To these may be added the bodies of numerous horses and mules, and even those of Indians and Guachos, who are frequently falling in the continued small hostilities between these races. All these must conduce to make the country a land of luxurious plenty to the armadillos of the present time, compared to what it must have been to their remote ancestors in ages long gone by; and as they feed more daintily, as well as more abundantly, than when they were confined to their wild roots, and insects, and worms, with a small lizard or snake now and then, by way of tit-bit, we may conclude that they have not only become more abundant in numbers, but of larger size, and more juicy in flesh. It is on this account also that their stomachs may now have less of the muscular or gizzard structure than when their food was more of a vegetable character.

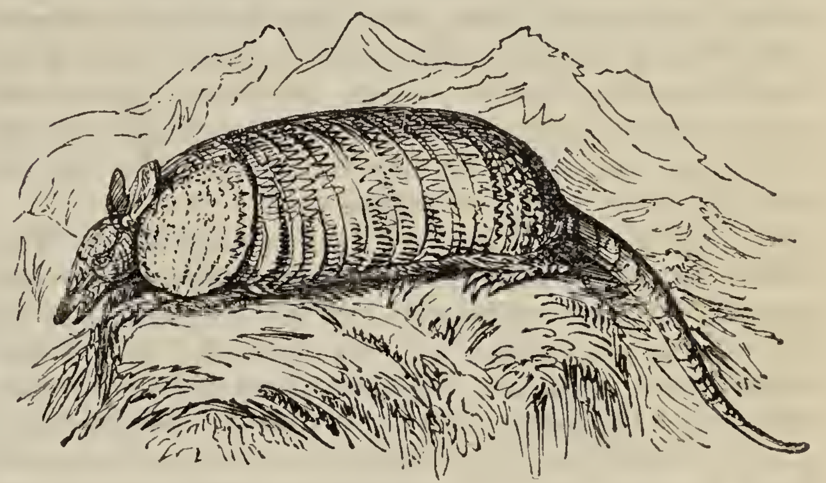
This effect of the colonisation of South America upon the armadillos is probably a greater anomaly in the effect of colonisation upon wild animals generally than the armadillos themselves appear to be in the class mammalia. The bear, the buffalo, and many other of the wild animals of North America, have vanished from great part of the United States; the antelopes of Southern Africa have, many of them, ceased to appear within the territory of the Cape; and even the kangaroo of Australia is a rare animal, compared with what it was when the colony was first established in that part of the world. All these are animals more resembling those which are domesticated and attended to in Europe than the armadillos; and yet these appear to be the only race of living creatures, natives of a colonised land, which have really and substantially benefited by colonisation.

The armadillos are classed in the order of *Edentata*, or toothless animals, and, though they all have teeth, and some of them a greater number than perhaps any other of the mammalia, they are not improperly so classed, as their teeth neither have the structure nor perform the functions of teeth properly so called; whether they should form a sub-order, or group, or only a genus, as at present, is another matter, but not one of very much importance in the *knowledge* or use of natural history. There are points of family likeness among all the *Edentata*, from the sloths to the scaly *pangolins*, though the first of these more resemble the ordinary mammalia, and the last more resemble the *Monotremata*, at least in some points of their structure. Still the edentata, though curious animals, form perhaps as natural an order as any of the others; and were it not for the single structural peculiarity from which they are named, that order might include the monotremata.

For the reason already mentioned, the Linnæan division into species, founded on the number of separate plates between the buckler on the shoulders and that on the crupper, is inapplicable, and though it were applicable, nothing could be founded upon it, and therefore it is useless. Baron Cuvier's five sections or subgenera are perhaps the best arrangement in the present state of our knowledge; but they too are founded chiefly upon external characters, and some of those characters appears a little inconsistent, as, for instance, distinguishing, by the number of their *teeth*, animals of which the general character is that they are *toothless*. Cuvier's sections are *Cachicames*, *Apars*, *Encouberts*, *Cabassous*, and *Priodontes*, the first and third containing three species each, and the remaining three only one each, making in all nine known species. We shall shortly notice the sections in their order.

Cachicames. These have seven or eight teeth in each side of both jaws, the muzzle long and pointed, and the tail also long. They have four toes on the fore feet, and five on the hind ones. The claws on the two middle anterior toes are very large and strong; the lateral ones, especially the inner, are much shorter, but also strong and well adapted for digging. The fore feet thus form pointed spades, which penetrate the earth much better than if the claws were all of equal length. The species included in this section are said to be more vegetable in their feeding than some of the others; some of them come abroad from their burrows during the day, and run with considerable swiftness. The following are the species.

1. *The Peba* (*Dasypus peba*). This is the pig-headed armadillo of Grew, the nine-banded, the eight-banded and the seven-banded of some of the systematists; and they might have added six-banded, for some individuals have that number. It is said that the additional bands are formed by separation from the bucklers, or rather by the production of new matter, as the markings of the bands and bucklers are not the same, and that these take place as the animal increases in age and size.



The Peba.

The usual length of the full-grown peba is about one foot four from the point of the snout to the root of the tail, and the tail is about one foot two, making the total length of the animal two feet and a half. The head is long and slender, the muzzle much produced, and terminating in a snout not very unlike that of a pig. The ears are rather long, and stand close together on the top of the head; and the eyes, which are small, and have the opening of their lids nearly lengthways, are placed in the middle of the sides of the head. The gape extends a considerable way backwards, and there are eight straggling teeth in each side of both jaws. The buckler or helmet on the head extends from the ears to the muzzle, and in breadth to the orbits of the eyes, which it partly overshadows and protects. There are small hard scales on the ears, and partially on the cheeks, throat, and other parts of the under side of the body. The buckler on the shoulders inclines forward on each side of the neck, and reaches down till it completely conceals the elbows; it is made up of a series of united stripes or pieces, increasing in breadth as they advance towards the back, and all of them slightly concave toward the head. These stripes are formed of hexagonal pieces of small size but very closely and firmly united. The buckler on the crupper is of similar structure, only the stripes of it are slightly concave toward the insertion of the tail, which its posterior margin nearly surrounds. The intermediate bands, which vary in number, as already mentioned, are composed of angular pieces, larger in size and different in shape from those which compose the bucklers. The tail is thick at the root, nearly two inches in diameter, and it tapers gradually to a point. It is covered with a number of rings, and admits of considerable flexure. The legs are short and the feet smaller than in some of the other species. A considerable quantity of hair covering the under part appears from below the edges of the armour.

The colour is blackish, and hence it is sometimes styled the black armadillo.

This species is very generally distributed, and also very abundant. It is found from Guiana to pretty far south in Paraguay; it frequents the open fields and not the woods, and it does not quit though man takes possession and cultivates. It is nocturnal in in its habits, very timid, tolerably swift in its pace, and a most expert burrower. Its flesh is more esteemed by persons of European extraction than that of most of the others, partly, no doubt, because it is *understood* to live more upon vegetable matter. But birds which live on vegetable matter are not so highly flavoured as some of those which live upon animal substances, and that may be the case with armadilloes, which, as has been hinted, have some resemblances to birds. It has not been ascertained whether this species has cœcal appendages to its intestines, though these are found in other species said to be more fond of animal food.

2. The Mule Armadillo (*Dasypus hybridus*). The trivial name *hybridus*, given to this species, is rather absurd, because no species can be a hybrid, and no hybrid can originate a species; and the only thing mulish about this one is that the ears stand up something after the fashion of those of the common mule. This species does not appear to have been named from the number of intermediate bands, which are said to be six or seven. It is much smaller than the peba, and has the tail and legs shorter and the ears longer; altogether it is not above eighteen inches in length, of which the head and body occupy two-thirds, and the tail one. The brood of the female are numerous, sometimes as many as a dozen, and it is said that each litter are always all of one sex. D'Azzara found this to be the case in one instance; but in animals so numerous, one instance is not sufficient to establish a general fact. This species extends into more temperate latitudes than the former, and is found abundantly in the pampas, even to the southward of Buenos Ayres. It is diurnal in its habits, and not nearly so dexterous in burrowing as the peba.

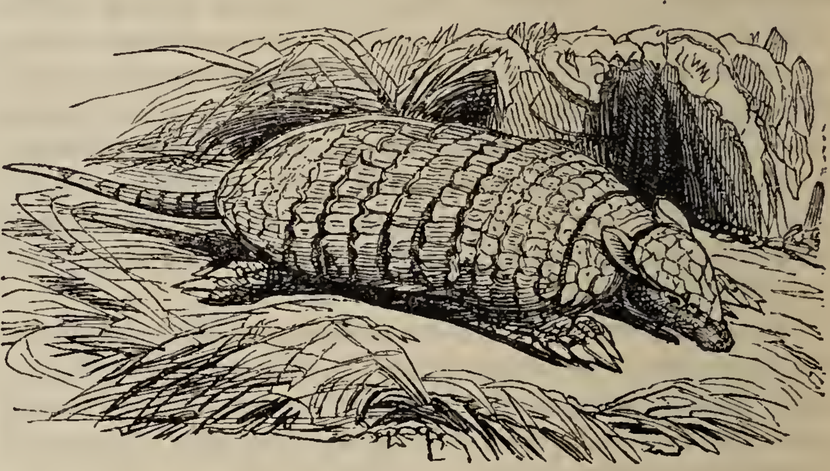
3. *The Totou verdadeiro* (*Dasypus verdadeiro*) is a species resembling the former in many respects, but much less perfectly known. Its chief character is a sort of horn, or single horny sheath on the point of the tail. It has been observed in Brazil, where it inhabits the woods, lives in burrows, and is diurnal in its motions.

Apars. This division resembles the former in the the structure of the feet; but the teeth in each side of both jaws are generally nine or ten. They have the power of forming themselves so completely into a ball, that they may be rolled, tumbled, and thrown about without sustaining any injury. There is but a single known species; and that one, though found in Brazil, in Paraguay, and as far southward as Buenos Ayres, is by no means abundant in any known locality. That species is—

4. The *Mataco* (*Dasypus apar*). This is the three-banded armadillo of Linnæus, and the three bands on it are very conspicuous, more from the larger size of the pieces of which they are made up, than of the pieces which compose the bucklers. The head of this species is about three inches long, and pear-shaped; the body a foot long, and rather lumpy or clumsy; and the tail is not quite two inches long, flattened and blunted at the point. The ears are short, rounded, and wide apart from each other. The bucklers advance very far forward toward the chin, and descend very much at the crupper; and the pieces of which they appear to be made up are so irregular that it is not very easy to trace them in regular transverse rows. The intermediate bands are formed of granulated rectangular pieces, which form a remarkable contrast with the rest of the armour. It is said not to burrow, at least to the same extent, or with the same facility, as most of the other species; but still it is not without its means of defence in the facility and firmness with which it rolls itself into a perfect ball, and thereby presents nothing but armour at all points. Its habits are not very well known.

Encouberts. The animals of this division have nine or ten teeth on each side of both jaws, and also some teeth on the intermaxillary bones of the upper jaw, which may perhaps be considered as a sort of fore-teeth. They are not, however, incisive teeth in any ordinary meaning of the term, but round, standing apart, and fit only for prehension, like the teeth in the jaws, so that the animals of this division have still only the same kind of teeth as the others, though two of them are differently placed. They have five toes on all the extremities. There are three known species.

5. The *Poyou* (*Dasypus encoubert*). This is the six-banded armadillo of the Linnæan arrangement, and the weasel-headed armadillo of Grew, by which name it is still often popularly described in this



The Poyou.

country. Its length is about sixteen inches, and the tail about eight. The head rather large, flat on the forehead, triangular in shape, and blunt at the muzzle. The eyes are rather small, and the ears erect, and wide of each other. The armour does not descend laterally so low, either on the body or the legs, as in the species hitherto described; the legs are also larger, thicker, and stronger; the feet and claws longer; and the whole expression indicative of a more powerful and energetic animal. The armour on the back is very broad, and the breadth of the animal corresponds, so that it appears one of the widest of the mammalia in proportion. The great breadth is particularly conspicuous when it squats down, as it often does, for the purpose of rest, and probably also of concealment; as in these cases it entirely folds up the legs, and the edges of the armour touch the ground. The number of moveable bands is not constantly six, but often seven or eight; and these and the bucklers are of a whitish colour, while the feet, which are covered with scales and tubercles, have a tinge of yellow; from between the bucklers there arise a few greyish bristly hairs; and the under part of the animal is tolerably well supplied with hairy covering.

The intestines of this species is furnished with two small *cœca*.

This is one of the most active of the armadillos; it runs with great swiftness, and even, notwithstanding the little flexibility of its back, makes attempts at a sort of jumping. It is a bustling animal, and appears to wish to know what is going on; for if hallooed to in its burrow it replies by grunting; and if the noise is continued, it comes out to see what is going on. Still it has no means of defence but flight or burrowing, as it does not offer to use either its teeth or its claws when assailed. It has already been mentioned that its pace is rather swift; and in dexterity of burrowing it is perhaps superior to any of the genus. It is particularly fond of carrion; and as it is an active animal, it finds abundance of that description of food, and is in consequence generally fat. The Indians seek after it with considerable avidity; but the descendants of Europeans seem to have a prejudice against its flesh, in consequence of the nature of its food; though it is probable that some of the species which they eat with the greatest relish, and which are night-feeders, and their food imperfectly known, may as frequently regale themselves on putrid bullock as the encoubert. In Paraguay this species is very plentiful. The mammæ in the female are only two in number; the broods, in all probability, exceed that, though their positive number is not very well ascertained.

6. The hairy armadillo (*Dasypus villosus*) resembles the encoubert in many particulars, but it is smaller in size, has the tail shorter in proportion; and the body is much more hairy, as brown hairs appear not only in the joints between the bands and bucklers, but over their surfaces. The length of this one is about fourteen inches, and that of the tail about five.

The hairy armadillo is not found in the tropical parts of South America or even in Paraguay. It resides chiefly in the drier parts of the pampas, never approaches the humid grounds, and lodges and nestles in natural holes in the ground rather than in burrows of its own excavation. It can burrow, however. It is very fond of carrion; and when the surface of the carcase on which it preys is dry and hard, it burrows in below, where the parts in contact of the ground have begun to decay; and feeding away as the carcase putrefies, it hollows out the whole interior, leaving the dry surface like a thin and empty shell. The flesh of this species, notwithstanding its feeding, is said to be very delicious.

7. The *Pichiy* (*Dasypus minutus*). This is the pigmy armadillo of some authors, and the smallest of all the known species. It inhabits the same regions as the one last mentioned, and extends even farther to the southward, being found on the borders of Patagonia. Except that it lives in burrows of its own excavation, its habits very much resemble those of the hairy armadillo. The whole length is only about ten inches, and the tail nearly half as much more. The head is small, the neck short, the buckler on the head shadows the small eyes, and below them there are tufts of hair on the cheek. There is a good deal of hair between the moveable plates, but it is not so much distributed over the body as in the last-mentioned species.

Cabassous. The animals of this division have generally nine or ten teeth in each side of both jaws, though it should seem that the number of teeth, like that of the moveable bands in the armour, is not constant, and therefore not implicitly to be depended upon for the purposes of classification. There are five toes on each of the feet; the first, second, and fifth on the fore feet having the claws moderate, but the third and fourth having them of immense size. There is only one known species.

8. The *Tatouay* (*Dasypus tatouay*). This is the one-banded armadillo, though in fact the number of moveable bands is about twelve. The length is about nineteen inches, and the tail between seven and eight. It is not so much fortified by armour as that organ in the other species, but covered with detached scales or crusts. The head is long and the muzzle pointed, but the forehead round; the ears are large, and at a moderate distance from each other. It is much more tropical than many of the other species, being found in Guiana and Brazil, but rarely indeed even in the upper part of Paraguay. Its habits are very imperfectly known.

Priodontes. The animals of this division have the same large claws on the middle toes of the fore feet, and the teeth in each side of both jaws vary from twenty-four to thirty-six. It is from this great abundance of teeth that the division is named.

The giant armadillo (*Dasypus gigas*). This is the twelve-banded armadillo of some authors, and so far as is known, the number of bands intermediate between the bucklers amounts to twelve or thirteen. It is rather a tropical species, but it is found in Brazil and the northern parts of Paraguay, where it never appears in the plains, but keeps to the great forests, and burrows in the ground with great facility. The head is long and very slender, the ears rather short, the buckler formed of distinct transverse bands very close to the neck, nearly meeting under the throat, and very concave forwards. The buckler on the crupper completely invests the root of the tail, and the concavity of its transverse pieces is turned backwards. The scales on the moveable band and also the markings on the others are rectangular. This is by far the largest of all the armadillos, being three feet three inches in length, with the tail one foot five inches more. The tail is very thick at the root, tapers to the point, and is covered by small plates forming a sort of spiral row.

The habits of the great armadillo are not much known, but observation shows that it is very fond of putrifying animal matter, and that it will dig deep into graves in order to get at the bodies of the dead.

Such is an outline of most that is accurately known of the natural history of these most singular animals.

ARRAGONITE, or prismatic limestone. An earthy mineral which is usually divided into two sub-species. The common Arragonite is of a greenish white tint, in some specimens approaching to a violet blue. It occurs massive, and is frequently crystallised. The primitive form of its crystals is an oblique four-sided prism.

Arragonite is found in the trap-rocks of Bohemia, of the Brisgau, and of Lower Italy. Very beautiful specimens occur at Schwartz in the Tyrol, one of which, preserved in the mineralogical collection at the British Museum, is represented on the next page. It strikingly resembles some portions of the animal viscera, and in fact appears like a part of the human frame petrified. It is there associated with copper-green, grey copper-ore, ochry-brown iron-ore, iron pyrites, quartz, and calcareous spar; in Spain it occurs imbedded in gypsum, along with reddish-brown quartz crystals; near Iglo in Hungary, it is accompanied with calcareous spar, ochry-brown iron-ore, and copper-green; near to Schemnitz in Hungary, its accompanying minerals are brown-spar, silver-ore, and galena; at Salfeldt, the principal mineral with which it is grouped is compact brown iron-ore, along with blue copper, and pyramidal calcareous spar; and it is found in compact lime-stone at Wolfstein in the Upper Palatinate. It is frequently found in Scotland, where it occurs along with galena, and in the secondary trap-rocks.

Arragonite.

The coralloidal arragonite, like the preceding species, is massive in its character, but the fragments have a peculiar wedge-shaped appearance.

ARROW GRASS (*Triglochin* of botanists.) A family of bog plants, mostly natives of Europe. There are six species: three of which are found in Britain.

ARROW HEAD. The Sagittaria of botanists: a genus of fourteen species found in low marshy places in all quarters of the world. Linnæan class and order *Monœcia Polyandria*; natural order, *Alismaceæ*. Generic character: flowers perfect monœcious and diœcious; calyx three sepaled; corolla three petaled; stamens inserted on the receptacle; filaments like threads; anthers ovate, double; cells discretous, opening outwards; styles numerous, very short; stigma acute, persisting; caryopses numerous, hard; seeds albumenous. This genus receives its name from the shape of the leaves being like the head of an arrow; often seen in the shallow parts of lakes and rivers.

ARROW ROOT of the druggists, and MARANTA of botanists. A family containing fourteen species, all considered ornamental: natives of the torrid zone. Linnæan class and order *Monandria Monogynia*; natural order *Canneæ*. Generic character: calyx double, both sides three-parted superior; corolla one petaled, three-cleft, leaning back, segments thrice two-parted; stamens, filaments like petals, two-parted, bearing one anther, style twisted; stigma three-sided. *Maranta arundinacea* yields the nutritive fæcula of the shops.

ARSENIC, a mineral which appears to have been one of the first known in medicine; it was also used to a considerable extent for the purpose of painting, even in the time of Theophrastus. It presents a variety of appearances dependent on the various bodies with which it is combined in its mineral state; but one very marked peculiarity is the strong odour of garlic which results from raising its temperature. This however is a test that should be employed with care, as the arsenical vapour which produces this odour is in the highest degree acrid and poisonous. It is electro-negative, and belongs to that class of metals whose oxides rather act as acids than bases, in the compounds they form with other oxidated bodies.

Native arsenic when fresh fractured is of a whitish grey colour. It occurs massive, and is externally either rough or granulated.

It is generally found in veins in gneiss, micaceous-slate, and clay-slate; and is a frequent precursor of rich masses of silver or cobalt: it is also associated with red silver, sulphuretted silver-ore, and arsenical pyrites. The mines of Kongsberg in Norway produce it in considerable quantities; as also do those of Saxony, Silesia, Suabia, and Hungary. The accompanying sketch is taken from a specimen from Nagyagin, Transylvania.

Arsenic.

We may now enumerate some of the principal mineral combinations of arsenic. Arsenical silver is massive in its character, and has a specific gravity of 9.440. It is found in Germany and Spain.

Arsenical pyrites is usually divided into two species; prismatic arsenical pyrites and di-prismatic arsenical pyrites. The first of these is of a pale steel grey colour, with a metallic and shining lustre: it occurs massive, in the form of oblique four-sided prisms. This species is again sub-divided into common arsenical pyrites, and argentiferous arsenical pyrites; the latter occurs abundantly in Cornwall and Devonshire, as well as in the north of Europe. It is from this one that the white oxide of arsenic is principally obtained, and artificial orpiment is also prepared from it.

Argentiferous arsenical pyrites is distinguished from the last named mineral by its inferior lustre and the smallness of its crystals; it is of rare occurrence, and is almost exclusively confined to the north of Europe.

Arsenic oxide nearly resembles PHARMACOLITH, which see.

ARTABOTRYS (R. Brown). A sweet scented ornamental evergreen shrub, introduced from China. Linnæan class and order *Polyandria Polygynia*; natural order *Anonaceæ*. Generic character: calyx three parted, larger than the corolla; segments lanceolate; corolla six-petaled, alternately roundish and pointed; stamens below the germen; style very short, and simple; berries attenuated on each side, two-seeded.

ARTHROPODIUM (R. Brown). A genus of five species of perennial herbs, chiefly natives of New Holland. Linnæan class and order *Hexandria Monogynia;* natural order *Asphodeleæ.* Generic character: corolla six-petals, spreading; the margin of the inner petals undulating or fringed; pedicles jointed; stamens below the germen; filaments bearded; anthers erect, base with a margin; style like a thread; stigma hairy; capsule three-celled, three-valved; seeds angular. These plants are only seen in botanical collections or herbariums.

ARTICHOKE. The *Cynara scolymus* of botanists. Of this genus there are eight species, two of them cultivated, and long introduced from the south of Europe. Linnæan class and order *Syngenesia Æqualis;* natural order *Compositæ.* Generic character: scales of the anthodium fleshy at the base, armed with spines; receptacle fleshy, chaff cut and defensive; pappus seated, and feeble. This large exotic herb is cultivated for the fleshy receptacle or base of its flowers for the use of the table. It is more a delicacy than a necessary of the kitchen garden, but as it is often partaken of by valetudinarians, who can relish nothing else, and moreover, considered nutritive and not destitute of some valuable medicinal qualities, it is held in high estimation.

Cultivation.—As great bulk in the plant and consequent amplitude in the flower constitutes the principal value of the artichoke, much care is bestowed on the preparation of the soil intended for them, as well by deep trenching or double digging as by enriching with good dung or compost. The favourite soil of these plants is a deep, rich friable loam; and as it has been observed that they grow luxuriantly in the neighbourhood of the sea-shore, a moderate portion of salt is supposed to be necessary to them. Artichokes, however, will succeed anywhere, provided the ground is made deep and rich enough.

New plantations are made in the spring. The ground intended for them should receive a good coat of rotted dung, five or six inches thick. This should be trenched in at least sixteen inches deep, and if it be a clayey subsoil, twenty-four inches will be still better. If the natural soil be considered too heavy and tenacious, a portion of sand, or of some looser description of earth may be incorporated when the trenching is done. This work should be done any time between the first of October and beginning of March, while the weather is dry, in order that the ground may be settled and ready to receive the plants about the middle of April. Previous to planting, say about the middle of March, the ground should receive another coat of well rotted dung, or rich compost: this should be neatly digged in, the surface levelled, and divided into four-feet beds, along the middle of each the rows of plants are to stand.

The root of the plant is large and fleshy, having strong spurs, which descend deeply into the ground. This is the reason why a deeply lying stratum of rich dung is required for the points of the roots. The crown of the roots is compound, that is, composed of one central and many surrounding buds, which shoot up during summer. A root, if left to nature, becomes, in the course of years, very much extended laterally; but as this would yield a great number of heads of too small a size, the proper practice is to reduce the number of suckers, or side branches, in the beginning of April, leaving only four or five of the strongest to form sizeable heads.

It is from this necessary dismemberment of the old stools that young plants are obtained with which to make new plantations. Drawing away the earth from the base of the stool, allows the side shoots to be slipped off with ease, each with a few fibres attached. A lot of the largest and best rooted are chosen to be planted; part of the top of their leaves is cut off; a line is stretched along the middle of each bed on the prepared ground, and the plants introduced at two feet distances apart. The plants should be let in at least eight inches deep, and if the soil be very dry a little water may be given to each. This, together with the manure previously digged in, will expedite their rooting, and ensure a luxuriant growth during the ensuing season.

The summer management only consists in keeping the ground free from weeds by deep hoeing, occasionally; intervals between the rows being usually cropped with some low growing summer plant as lettuce, dwarf beans, or the like.

If the season be favourable and the plants have taken kindly to their new place, they will each produce small heads in the autumn. These, perhaps, may be too small for plain boiling; but they are used in other ways by the cook, or for slicing in salads.

The roots are liable to injury from frost, and therefore, on the approach of winter, the precaution called the *winter dressing* is bestowed. About the 25th of October, the largest dangling leaves are trimmed away from each stool; the central leaves are preserved and loosely tied together with a string of bass, a quantity of loose, dry litter, or fern is brought and piled round the leaves and extending over so as to cover the roots. The whole surface of the ground is then digged over, working the earth towards the rows of plants, so that each row shall stand in a ridge, a graduated hollow being left along the middle of the intervals. This manner of laying the surface secures the plants not only from frost, but also from being soaked and chilled by the winter snow or rains.

Thus secured, the plants remain till winter is past, and until the time arrives when they receive their *spring dressing.* This may be done sooner or later, according as the season is more or less favourable. From the 20th of March to the 10th of April is the usual season for this work. What was done at the winter dressing is reversed at this; the earth is digged away from the rows of plants, exposing the roots sufficiently for the dresser to make a proper selection of the shoots to be left for a crop, and to reject the supernumeraries. Thus, the selection of the shoots, is the only point in which much judgment is required in the cultivation of the artichoke. If the land they grow in be poor, very few heads should be left to be perfected; two or three in this case is enough if large flowers are desired; if the ground be in good heart, and the stools appear strong, five or six of the strongest shoots to yield heads may not be too many; for in proportion to the luxuriance of the stool should it be called on by the manager to yield accordingly. In choosing the shoots the strongest near the centre should be preferred, otherwise the stool becomes irregular in form, by creeping away from its proper station in the row.

The heads are not only enlarged by leaving but a few to be perfected on each plant, but also by divesting them (the principal stems) of their branches, which also bear smaller heads: and these when no larger than a hen's egg are useful in the kitchen. In gathering the principal heads for use, they should not be cut, but wrenched or twisted off; by which many of the strong fibres of the stem which penetrate into the bottom are withdrawn, thereby improving the quality of the latter when brought to table. The stems may be cut down as soon as the flowers are off.

There are two kinds of artichoke in cultivation, viz., the green globe, which is the largest, and the purple globe, which is said to be more delicate and superior in flavour. Either seeds or roots may be purchased at the seedsmen's shops.

A plantation of artichokes, if properly planted at first, and receiving a dressing of good dung every third or fourth year, deeply digged in among the roots, with careful treatment at the spring dressing, and well secured from frost in winter, will continue productive for a considerable period—say ten or twelve years. When a plant is four or five years old, however, it is then at its best.

ARTICULATA—jointed animals. The third of the grand divisions into which Cuvier arranges the animal kingdom, and the second of the invertebrated or spineless animals. The species which it comprehends are exceedingly numerous and varied in their forms and their habits and economy, so that they not only extend to genera, groups, and orders, but admit of division into four classes—*Annellida*, *Crustacea*, *Arachnidæ*, and *Insecta*, all of which have their characters as classes as well defined as those of the four classes of vertebrated animals—*Mammalia*, *Birds*, *Reptiles*, and *Fishes*. But as these, in all their classes, and in all the varieties of each class, preserve the fundamental characters of the grand division—the articulated spine and the other parts of the internal bony skeleton, which gives form and support to their bodies, and affords points of rest, centres of motion, and levers, by means of which the muscles or organs of motion are enabled to act; so the *Articulata*, destitute in every instance of even the slightest vestige of spine or internal skeleton, preserve their fundamental character of a jointed external covering, which in like manner determines their shape, and gives insertion to their organs of motion. In the majority of cases, they are, like the vertebrated animals, furnished with distinct organs of locomotion; with feet, with wings, or with fins (or at least with organs which answer the same purpose), according to the element in, or on, which they move; but there are some which are destitute of such organs, and these crawl or wriggle along by the help of the edges of their rings, or by the flexures of their bodies. Some of the apodal, or footless articulata, as the common earth worm and the leech, appear indeed to derive advantages in their locomotion from the want of an internal spine. Spined animals cannot lengthen their bodies beyond the length of the spine stretched to a straight line; and they cannot shorten them in any way but by bendings or flexures of that organ—at least the changes that can be made in either way are so trifling, that they are not worthy of taking into account. The spine, though it has its advantages, has thus, also, its disadvantages. Its contents, the continuation of the nervous mass, are too essential to the life of the animal, for admitting of alterations by lengthening and thickenings by contraction, as these would disturb, or possibly suspend the functions of those nerves which, originating in the contents of the spine, are essential to the motions of the animal. But the articulated covering of the animals under consideration, has no immediate connexion with their nervous mass; and so when necessary to the habits of the animal, lengthenings and shortenings of the body, by expansions and contractions of the spaces between the rings, may take place without any interruption or injury to the sentient system. When this takes place to a large extent, the rings themselves vary in breadth and diameter, widening and becoming smaller when the animal stretches itself, and narrowing and expanding in diameter when it shortens. Thus we see that every varied structure of the animal frame has its peculiar advantages; so that, however different they may be from each other, we cannot, when we take into consideration the functions which they have to perform, say that one is better than another.

This lengthening and shortening of the body are required only in those species which have not feet, and they are confined to certain species of the annellidæ. The other orders of articulated animals have feet, and have them articulated, or jointed, as well as the vertebrated animals. The only difference, except number, size, and form, are not merely similar to the characteristic distinction of the grand division, but actually part of it. The articulations of the legs are in the covering, and the muscles and all the other organs are within; and though there are in some, as in certain joints of the large lacs of crabs, internal substances of a bony, or rather cartilaginous nature, which in part support the muscles, there are not, in any degree, approximations to an internal skeleton: they are appendages to the external crust, and articulated to that, and to that only.

When we attentively consider legs of this construction, we find that they possess many valuable qualities which cannot be possessed by legs with internal bones, and the muscles and other soft parts on the outside. The external crust is stronger, or, at all events, stiffer than the same quantity of matter in a solid bone, upon the same principle that a hollow cylinder of metal is stronger or stiffer than a solid rod containing the same quantity in an equal length; and the strength is very generally augmented by the different articulated pieces being spindle-shaped, or thicker in the middle than at the ends, and having the longitudinal outlines curved. By this means every part of the surface resists pressure like an arch.

It is also easy to see that, shielded as they are in the crust, or other firm articulated covering, the soft parts are far more safe from injury than if they were external, with the bone inside, against which they might be pressed, and nothing to defend them but the soft integuments. The leg of the articulata thus bears something like the same relation to that of the vertebrated animals, as a leg clad in armour bears to a leg which is naked; only the advantage is greater, because the soft parts of a mailed leg, when pressed by dinting the mail, are resisted and crushed midway by the bone; whereas those in the articulata are resisted only at the opposite surface; and as the pressure there is, as it were, against the under or concave side of the arch, it has a tendency to give way a little, and by its elasticity take off much of the injury of the crush. In consequence of this structure it is demonstrable, upon the most simple and obvious principles of mechanics, that the limbs of the articulata, and their bodies, in so far as these are similarly formed, can, without injury or inconvenience, bear pressures, crushes, or blows, proportional to what would maim or even destroy the stoutest of the vertebrated animals. A beetle, for instance, suffers no injury, by a fall from a height, or the fall of a substance upon it, which, estimating according to the relative weight of the animals, would dash an elephant to pieces, or, at all events, crush it to death; and the tiny leg of an ant can bear, without the least injury, a pressure, the relative effect of which would crush the paw of a lion to jelly. We shall afterwards have occasion to see that very many of the articulata are, not occasionally only, but habitually exposed to such pressures; and that if they had internal bones and the soft parts outside, they could not exist.

But the advantages of this structure are as great in action as they are in endurance. The muscles, inserted as they are in the opposite sides of the two jointed pieces, can exert their contractile force, either in bending or straightening the joint, much more effectively than can be done by external muscles, as they have the advantage of the whole lever power on both sides of the joint, and act in the straight line; while the external muscles very frequently act on the short end of the lever and have, besides, much of their force spent by their acting obliquely, and often through the medium of straps and pulleys, which, smoothly as the working surfaces of animals move upon each other, always destroy some of the power by friction. In the case of the internal muscles (that is, muscles in the inside of the parts which they move), no tendon, pulley, or ligamentous strap, is required. From the one point of insertion to the other the whole can afford to be efficient contractile fibres; and as those fibres are also, from their position, able, in almost every imaginable case, to exert the very maximum of their effect, it is not too much to say, that bulk for bulk, or weight for weight, an internal muscle of one of the articulati can act with twice, nay, with ten times the effect of an external muscle in any skeletoned animal. But bulk for bulk, or weight for weight, is not the means by which to estimate muscular activity, nor even a safe element in that estimate. Both bulk and weight are in themselves obstacles to motion, rather than sources of it; and in a muscle two pounds in weight there must be one pound of the motive energy expended in moving the additional pound more than would be necessary, if the muscle weighed only one pound. Suppose a certain muscle in an elephant to weigh a quarter of a hundred weight, or 28 pounds avoirdupois, and a certain muscle in an ant 1 grain troy; then, estimating in round numbers the pound avoirdupois at 7000 grains, the relative weights of the muscles will be 196,000 for that of the elephant, and 1 for that of the ant. Therefore, the loss of power from the overcoming of the mere inertia in the muscle of the elephant, is nearly two hundred thousand times as great as that in the ant. It must be borne in mind, too, that this overcoming of the inertia of the muscle is not a mere initial resistance, which can be overcome by any momentum after the muscle is in action. The whole body of an animal does acquire a momentum, which, in rapid motion, takes off part of the general weight from the whole organs of motion; but no single muscle can possibly acquire a momentum which can in any way relieve it of the constant dead-weight of its own inertia. The contractions of a muscle are independent and separate efforts, no one of which transfers the least portion of energy or impetus to that which follows; and therefore the inertia, in time, becomes too much for the muscular energy; and the heavy muscle, when the bodies moved are in proportion, is always first exhausted by fatigue. The large, heavy, and handsome horses, employed in the brewers' drays in London, could not get through one day in a coal-wagon, or a common travelling stage, though for short distances, with rests between, they may pull one-half more than the horses employed in these.

Another advantage which the internal muscle has over the external one is, that no part of its energy is ever expended in stretching its antagonist. When, for instance, the muscles which bend the human knee, or the joints of the fingers, are exerted, the *extensor* muscles are pulled in length by the projection of the joint, as it bends, pulling the tendons which pass over it. This, no doubt, keeps the joint steady, but it also diminishes the effect of the *flexor* muscles in bending the joint. But as the internal muscles pass through the centre of motion, the one of them is not pulled in length by the contraction of the other; and therefore the whole energy of that which contracts is effective in bending the joint.

The mere fact of being internal, surrounded with fluids, protected from changes of temperature, and from all atmospheric action, is an advantage to the muscles of the articulated animals, which alone would give them considerable additional strength, and especially additional power of continuing in action without fatigue. It would be no easy matter to estimate exactly the effect of the resistance, the decomposing power, and all the other influences of the atmosphere upon external muscles; and it would, perhaps, not be more easy to reduce to arithmetic the influence of changes of temperature; but we feel both, and especially the latter, so much in our own case, as to leave not a doubt that, but for these, we should be both stronger, and less easily fatigued; and as that is the case with us, we may very safely conclude that it must be the case with all animals which, like us, have external muscles and internal bones.

These considerations, and many others which will readily occur to the reader who carefully examines what has been stated, tend to show the advantage, and not the advantage only, but, if the expression may be admitted, the *necessity*, of the articulated structure in very small animals, which have to make their way along the surface of the ground, or even which sport in the air, as is done by gnats, and many other tiny creatures during almost the whole period of their winged lives. If we were to suppose the mountain rocks shattered into fragments, varying from the size of a haycock to that of our largest buildings, and the whole scattered miscellaneously about, so that in some cases an ox could pass under, and in some others only over them; if we were to suppose this, and that it were the general character of the earth's surface, then it would bear nearly the same ratio, and oppose nearly the same resistance to the progress of the larger mammalia as the common mould of a garden, with its admixture of pebbles, bears to the size, and opposes to the march of garden ants and the smaller beetles. We have ample proofs, in the smaller obstacles, by which their utmost exertions are foiled and defeated, that not even the fleetest of the mammalia, or those which are inured to the most stubborn and stony paths—the mountain-antelopes and mountain-goats—could make the least way over such a surface. It would be equally beyond their strength and their endurance: they could not accomplish it; and even if, in point of strength, they could, their flesh would soon be cut to pieces, and their bones broken to splinters by falls. But the articulated animal, defended by its crust, or other firm-jointed covering, and by the advantage of its internal muscles, performs its analogous, parallel, or even apparently more arduous labour, not only without injury, but without the least appearance of fatigue; for though we often find these little creatures in a state of repose, we can in no instance say that they are resting, because their leap, their march, or their flight, has fatigued them to exhaustion.

Thus we find, in the general structure of articulated animals, a consummate wisdom of design, and the very perfection of adaptation. So perfect and so striking, indeed, are these, that, in the minutest of the animal kingdom, it is difficult to imagine how any others than articulated ones could perform their functions, and preserve their existence; and when we reflect on the almost countless number of the genera, the absolutely countless myriads of some of the species, and how industriously and incessantly they are all at work, we see what a mighty blank there would be in creation—a blank, the occurrence of which would suspend all the other operations—if this division were to cease to exist.

But, while we look with admiration upon one division, and revere to the fullest extent the demonstration of Creative wisdom which it displays, we must not suppose that the special wisdom has been displayed, or the superiority of fatherly care expended upon that; for when we turn our attention to the next, be it what it may, we find that though the mode is different, the demonstration of wisdom, power, and goodness is still the same; and though we follow it to that shadowy boundary, where our knowledge of the creature is in a great measure matter of imagination, we find, even then, that the demonstration of the Creator is subject to no diminution, but that, like His own eternal and immutable essence, it is at all times and in all places exactly the same.

Though the limbs and other moving parts of articulated animals possess what may be considered as the maximum of strength and endurance in the same quantity of matter, they by no means possess the maximum of all advantages; and though we may with propriety reckon theirs the most powerful form of organisation, it is still an inferior form; as the very circumstances which give security and strength to the articulated members, limit them in that higher function which may be called *aptitude*. Every joint of theirs is, necessarily, from the structure of the parts, and especially from the moving power passing through the centre of motion, and being between the points of motion in the hard parts, little else than a common hinge, or *ginglymus*, as it is technically called. Such a joint, when well made (and all the natural joints of animals are well made), is, even in common mechanics, at once the most steady, and the one by means of which the greatest effect can be produced by the same application of force. But the hinge opens and shuts only in one plane; and if it is wished to turn the motion into new directions, there must be an additional hinge for every one of these. It is the same with the joints of the articulata; there must be as many joints as there are directions of motion; and as in any thing which is articulated there is always necessarily one piece more than the number of joints, the limbs in the articulata, to give them the same number of motions of which those of vertebrated animals are susceptible, would require a vast many more pieces and joints; so that to "bring up" the articulated animals even to the common active motions of the vertebrated, would require them to be at once very clumsy and very complicated. The sacrifice of power which arises from the structure of those animals which have internal bones and external organs for moving their bones, is not, therefore, a total sacrifice, it is merely sacrificing the single attribute of strength for the superior advantage of conveniency; and before an articulated animal could have the same conveniency—the same varied use of its members, it probably would have to exert more than a corresponding portion of the greater strength which it possesses in the single joint. The external muscles admit of all sorts of joints, from the hinge in one plane only, to the ball and socket which moves in all directions; and they admit of being so applied as to give to those joints every kind of motion, linear, rotatory and oblique. The human arm and hand, being intended for the most miscellaneous and universal application, are certainly the most perfect instance of articulation. And they are truly wonderful. If we take from the shoulder only, there are not very many joints; and yet the axis of the finger can be brought, without strain or exertion, to every point within a space of not less, even in a short arm, than two cubic feet. The human hand can divide space, and record the division by marks visible with a glass, to less than the 2500th of an inch, but say the 2000th, that makes 8,000,000,000 points in the cubic inch, or 13,824,000,000,000 in the cubic feet. The last is a number, not only beyond all counting, but beyond all ordinary comprehension; and yet it does not express all the positions of the fingers, even if we suppose the shoulder to be immoveable; it only expresses that very limited fraction of them which can be seen by the eye, aided by its glasses. But if we bring into consideration the flexures of the spine, the number becomes so great that instead of understanding it, we have hardly any name by which to call it. There is probably not, in the whole of the vertebrated animals, any organ capable of nearly so many motions as the hand; but in all cases, a much smaller number of joints effects every compound motion in those than in the articulata; and when we consider the state of the earth's surface, we cannot but perceive that the vertebrated animals are those to which it seems especially adapted; and that though the adaptation is equally perfect, the other tribes may rather be said to, be adapted to their particular situations upon it.

The inferior adaptation of the joints of the articulated compared with those of vertebrated animals are shown in many parts of their organisation. Their legs are more numerous, and the increased number appears to be equally necessary for the purposes of stability and of locomotion. They present a wider base both when the animal stands and when it walks; and in some species they spread so wide that the animal stands upon more than ten times as much ground as its body would cover; so that if we were to witness any thing like the same spreading of legs in order to obtain a base to stand on, in vertebrated animals, we should at once set them down as utterly deformed.

Another circumstance which points out the comparatively little freedom and range which there is in the joints of articulated animals, is the way in which the mouth opens. In all the vertebrata, the jaws, or in most cases only the under jaw, open downwards, and the two are always placed horizontally, the one upon the other: the great flexibility of the neck enables a mouth opening in that manner to get at and seize the food better than if it opened in any other; and in those which have the neck rigid, and which are invariably inhabitants of the water, the element in which they move compensates for the rigidity. But in the articulata, there is no motion of the neck by which the mouth can be guided to the food. They must advance upon it by progressive motion of the whole body, and therefore the jaws open laterally, and both mandibles have an equal degree of motion.

The senses of the articulata are not well understood. Many of them have eyes, and these of course have the faculty of sight; but their senses of hearing and smell are very obscure, not only as respects the organs in which they may be understood to reside, but as respects the fact of their being possessed by the animals or not. Their eyes are sometimes placed upon stalks or peduncles. At other times there are two kinds of them in the same animal: one kind simple and usually placed on the top of the head, the other kind compound, often very large in size, and placed at the sides.

The animals in this grand division are, however, so numerous, and differ so much from each other, that no common description can reach the details. The orders are tolerably distinct; and under the names of them will be found the distinguishing characters of each. See Annellidæ, Arachnidæ, Crustacea, and Insecta.

ARTOCARPEÆ — the Bread-fruit Tribe. A natural order of plants, containing many genera and species, which, from their value and importance, demand special attention. This order is by some authors looked upon as a subdivision of the urticeæ, or nettle tribe. The order is thus characterised:—flowers monœcious, in heads or catkins; calyx divided, membranaceous; stamens uncertain in number; ovary free, one or two-celled; style single, thread-like; stigma bifid; fruit usually a fleshy receptacle, covered with numerous pericarps, lying amongst the persistent calyces, or enclosing them within its cavity; occasionally consisting of a single nut, covered by a succulent involucre; seed solitary.

The plants of this order are trees, shrubs, or herbs, inhabiting chiefly tropical regions, more especially the East Indies. In this family, of which the Fig may be looked upon as the type, we meet with plants having very opposite properties, some being nutritious and salutary, as the bread-fruit, fig, and mulberry, while others, like the antiaris, are acrid and poisonous.

Most of the plants yield a milky juice, possessing a considerable degree of acrimony. This juice is, however, occasionally bland, and becomes an article of food. Many of the plants which yield an acrid juice furnish fruit of a mild and nutritive quality, and in some instances the fruit is acrid in its young state, but becomes innocuous when ripe.

We shall illustrate this important order by alluding to several of the genera included under it.

The genus *Artocarpus* (a term derived from two Greek words signifying bread and fruit), whence the name of the order has originated, is one of the most interesting.

Bread Fruit.

The *Artocarpus incisa*, Bread-fruit tree, a native of the Moluccas and the South Sea Islands, attains a height of thirty or forty feet, with a diameter of a foot or a foot and a half. It abounds in a milky viscid juice, and its leaves are two or three feet long, and often a foot and a half broad. Its fruit is fleshy, as large as a good-sized melon, and is used as a substitute for bread. It is baked as bread after the central pith is removed. When roasted or boiled, it is said to taste like the potato. The properties of this tree are summed up by Dr. Hooker in the following manner:—The fruit serves for food; clothes are made from the fibres of the inner bark; the wood is used for building houses and making boats; the male catkins are employed as tinder; the leaves for table-cloths, and for wrapping provisions in; and the viscid milky juice affords bird-lime.

The *Artocarpus integrifolia*, Jack tree, or Entire-leaved Bread-fruit, is found in the East Indies, especially in the Molucca islands, and has, along with the last mentioned species, been introduced into the West Indies. It is a tree about thirty feet high, having leaves from four to six inches long, and producing a fleshy oblong yellow-coloured fruit, which sometimes exceeds seventy or eighty pounds in weight. The fleshy part of the fruit is used for food, and forms a considerable part of the diet of the natives of Ceylon. It has a strong sweetish smell, is not relished by strangers at first, and seems to be difficult of digestion. The seeds resemble chestnuts, and are esteemed excellent.

The *Ficus*, or fig, is another important genus included in this order. This genus is one of the most extensive among plants. Many of the species attain a gigantic height, and are remarkable for their fructification, their milky juice, and the affinity they bear to the bread-fruit. The genus abounds in the tropical parts of Asia. In Dr. Wallich's catalogue, a hundred and five species are enumerated.

The *Ficus carica*, a native of Asia, but cultivated in the south of Europe, furnishes the common esculent fig. Figs are brought to this country from the Levant. They are demulcent and laxative, and enter into the composition of some pharmaceutical preparations. When roasted or boiled, they are used as cataplasms, and are frequently applied to the gums and throat to relieve inflammatory swellings. The milky juice of the *Ficus elastica* and *australis*, when evaporated, constitutes the common Indian-rubber or caoutchouc. Both these species are very tenacious of life, and can exist for months or years suspended in the air without any attachment to the soil. The *Ficus sycamorus* is the sycamore tree mentioned in the Scriptures. It yields an edible fruit. *Ficus religiosa*, the famous banyan tree, or sacred fig of the Hindoos, is one of the many astonishing features of Indian vegetation. Its branches bend towards the ground, take root, and thus form separate trees, which successively cover a vast space of ground, and furnish a most agreeable and extensive shade in warm climates.

> ———————— its wondrous branch,
> Bent down to earth, new stems can launch,
> Which upward spring to bend again,
> And form a forest o'er the plain.

The *Ficus Indica* resembles the last mentioned species in its mode of growth. A tree of this species is mentioned by Marsden as growing in Bengal, which had fifty or sixty stems, with a total diameter of 370 feet, and which afforded at noon a shadow, the circumference of which was 1116 feet. Gum lac is procured from this species. The bark of the *Ficus racemosa*, or red-wooded fig, is used as an astringent. The *Ficus toxicaria*, as its name implies, possesses poisonous properties. The Dorstenias are herbaceous Brazilian plants belonging to this order. The *Dorstenia contrayerva* has an astringent, bitterish, aromatic root, which is used as a stimulant diaphoretic. The *Dorstenia Braziliensis* is employed as an emetic, and its juice is put into poisoned wounds to avert bad consequences.

The morus, or mulberry, is also referred to this order. The black mulberry, originally a native of Persia, produces dark purple fruit, which has acid and purgative properties. It is used to allay thirst, and to act as a refrigerant. The white mulberry is so named from the colour of its fruit. A peculiar acid, denominated moroxylic, is obtained from it. The leaves of both the white and black mulberry are used to feed silk-worms. The *Morus tinctoria* yields the yellow die called fustic. The bark of the morus, or *Broussonnetia papyrifera*, the paper mulberry, a native of China and the Eastern Archipelago, furnishes a kind of paper, as well as a particular sort of cloth. The *Antiaris toxicaria*, or toxicodendron of Leschenault, yields the ipo, or upas-antiar, one of the famous Javanese poisons. It possesses properties similar to those of the upas-tienté, already described under the article Apocyneæ.

The American caoutchouc is obtained from the *Cecupia peltata*, a species of cannon-wood tree.

From the palo da vacca, the cow-tree of the Caraccas (a species of the genus *Brosimum*), a nutritious milky juice is obtained, which is highly prized by the inhabitants of South America.

ARUM (Linnæus). An extensive family of herbaceous perennial herbs, found in every quarter of the world. Linnæan class and order *Monœcia Polyandria;* natural order *Aroideæ*. Spatha of one leaf hollow. Spadix, apex naked, like a lengthened club, the base serving for a germen; anthers attached to the middle; glands of the top thready; anthers superior; filaments none; anthers seated transversely, two-valved; style none; berry one, or many-seeded. Of this genus there are thirty-nine species, which are botanically divided into three sections, founded on the form of the leaves, viz., composite, simple, and arrow-shaped. Many of them have thick tuberous roots. One, the *A. macrorhizon*, is extensively cultivated in China, and answers the same purpose there as the potato in this country. The *A. colocasia* is said to be cultivated in Egypt. The *A. maculatum* is the only British species, called provincially wake-robin, and is a common plant. It presents, however, the general character of the family.

ARVICOLA (the campagnol or meadow-mouse of Pennant). A genus of *Rodentia*, belonging to the very numerous natural family of the rats and mice. The principal difference of appearance between this and some of the other field mice, is that the tail is shorter, and covered with hair. The meadow campagnol (*Arvicola agrestis*) is a well-known and by no means rare British species. It is reddish brown on the upper part and ash-coloured below, with the tail only about one-third the length of the body. It inhabits meadows rather than corn fields, though it is sometimes accused of committing depredations on the latter, and it forms its nest of dried grass. The accusations about plundering the crops appear to be in a great measure disproved, or at all events rendered very doubtful, by the kind of places in which the animal is most generally met with. These are low-lying pastures covered with tall herbage, and, as it appears, the more moist the better they are liked. From this circumstance one would be led to conclude that its food is not entirely vegetable, but that it seeks insects and other small animals among the roots of the grass. Its history appears to be in some way confounded (at least in the books) with that of other field mice, which take up their abodes in drier situations, and more among the fields under crop.

Another species of this genus, new to British natural history, has been discovered by Mr. Yarrell, and was by that gentleman brought before the Committee of Correspondence and Science, of the Zoological Society of London, on the 22nd of May, 1832. This new species the discoverer has named *Arvicola riparia*, the bank campagnol, from the places which it chiefly inhabits, and in which it nestles. These are ditch banks and hedge bottoms, and it is said that the nest, unlike that of the other species, is formed of wool. The body of this species is smaller than that of the other, and the ears do not stand out so prominently. The tail is also longer, consists of four more vertebræ, and has the hair near the tip somewhat elongated. It is altogther a smaller animal than the meadow campagnol, but it has the appearance of greater energy and strength; and from some differences in the internal organisation it probably feeds still more upon animal matter. For an account of the foreign species see Campagnol.

ASARABACCA. The asarum of botanists, a genus of five species of hardy herbaceous perennials, natives of Britain and North America. Linnæan class and order *Dodecandria Monogynia*, natural order *Asarineæ*. Generic character: fruit inferior; calyx corolla-like, joined to the germen, bladder or bell-shaped, limb three-cleft, erect or revolute; stamens situate on the germen; filaments awl-shaped, anthers fixed below the apex of the filaments, two-celled; style thick, short; stigma six-lobed; capsule leathery, six-celled; seeds covered with a glandular substance, which, when off, shows a semilunar spot. This plant is said to grow wild at Rochdale, in Lancashire.

ASBESTOS, or AMIANTHUS, a mineral which derives its latter name from a Greek word signifying *unstained.* This was given to it by the early mineralogists from its power of passing through fire without soil or stain.

Flexible asbestos is of a whitish colour, approaching to green, but in some few cases of a bright red. It occurs in veins in serpentine at St. Keven, in Cornwall; and is found in a number of places in Scotland, especially in veins of micaceous slate at Glenelg in Inverness-shire. On the continent of Europe it is found in the Hartz, in veins of primitive greenstone; in Bohemia, in metalliferous beds, along with magnetic ironstone; in Upper Saxony, in veins of serpentine; and in a similar situation in Silesia and Switzerland. In Dauphiny, and on the St Gothard, it is found in contemporaneous veins in gneiss and mica slate. Uncommonly beautiful white and long fibrous varieties are met with in the Val de Serre in Savoy, at Cogne in Piedmont, and in the island of Corsica. The mineralogist may also readily supply his cabinet with specimens from the Uralian mountains, and from several places, in the United States of America.

Flexible asbestos was employed by the ancients to form a species of incombustible cloth; in which the remains of persons of distinction were consumed on the funeral pile. The cloth was afterwards withdrawn from the fire and inclosed with the ashes in an urn; and it is a curious fact that there now exists in the Vatican an asbestos shroud, containing ashes and burnt bones several thousand years old. The value of the asbestos mainly depends on the length of its fibres, and also on its whiteness and flexibility. In preparing the cloth, the asbestos is first carefully washed to free it from all impurities; and its fibres then laid straight and interwoven with flax. The fabric is then passed through a furnace, by which the flax and oil used in the operation of weaving are consumed, and the process is completed. The natives of Siberia weave gloves, caps, and purses of asbestos; and it is formed into girdles, ribands, and other articles, in the Pyrenees.

Asbestos is a very slow conductor of heat; and the editor of the present work was presented by the Chevalier Aldini with a glove of this mineral, in which the hand was so perfectly protected from the action of fire, that a bar of glowing hot iron might be grasped, and held for some minutes without the slightest inconvenience. This property has suggested the employment of an entire dress for the use of firemen. It has also been employed for an incombustible wick to a spirit lamp.

The *common asbestos* is darker in its colour than the preceding. It occurs massive, and in distinct fibrous concretions. When acted on by the blow pipe it fuses very readily into a slight greyish globule, similar to enamel. This mineral is found in serpentine and in primitive greenstone; it also occurs in metalliferous beds along with ironstone as well as with copper-ore. It is found, though but rarely, in Asia, and the United States of America.—See Rock Cork, and Rock Wood.

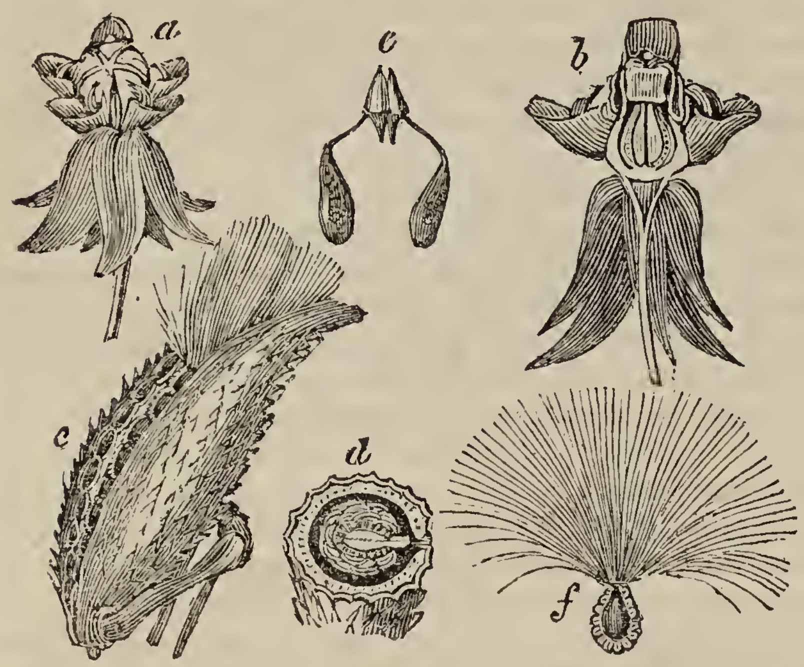
ASCARIS (Lamouroux). A genus of intestinal worms, of the order *Nematoides*, Rudolphi. Cuvier, having for its character, body cylindrical, attenuated at both extremities, the mouth surrounded or preceded by three tubercles. This genus is very numerous, and the animals which compose it are easily distinguished from all others, although the species are often confounded with each other. They appear to acquire their full growth in a very short time; some are scarcely half a line in length, while others attain a considerable size.

These worms are very common; some animals nourish many species, some of them in great numbers; others are solitary or rare, and we only observe them in certain seasons. The greater part of these animals are found in the intestinal canal; others in the interior of the lungs, and various other parts of the body.

There are nearly five hundred species described; about two-thirds are certain, the others still doubtful. It is probable that many remain undescribed, and in many instances the same species has been described under different names, in consequence of their appearance at different stages of their existence. The more remarkable species are the *A. lumbricoides*, Linnæus, which is sometimes found twelve inches long. It is found in the intestines of the human body, the ox, the hog, the horse, and the ass; they sometimes increase so much as to cause serious illness in children. The *A. mystax*, Rudolphi, is found to inhabit the intestines of cats, both in a savage and domestic state. The *A. maculosa*, Rudolphi, is found in the domestic pigeon and the turtle dove. The *A. echinata*, Rudolphi, is a very singular species; the head presents three great tubercles; the body is attenuated behind, and terminated by a tail, long, very slender, turned up at the extremity, and all the surface presents a number of little needles (*aiguillons*) directed backwards, situated in transverse ranges. It lives in the intestines of the gecko.

ASCLEPIADEÆ. A natural family of dicotyledonous plants, containing between forty and fifty genera, and upwards of two hundred and sixty species. They are closely allied to the apocyneæ, but differ from them in having the stamens united together so as to form one body, and the pollen coherent in masses of a waxy substance to the five corners of the flat central stigma. The essential botanical characters are in other respects so similar to those of the apocyneæ already detailed, that it is needless to enumerate them. The plants included in this order are generally shrubby, but occasionally herbaceous, and sometimes climbing. They are found abundantly in Southern Africa, India, New Holland, and the warm regions of America, more rarely in temperate climates. Some of the succulent genera inhabit the dry sterile plains of the African continent.

In their general properties also the asclepiadeæ bear a close resemblance to the apocyneæ. They yield a milky juice, which is acrid, bitter, stimulating, and sometimes poisonous. Many of them are used in medicine, and some are employed as articles of diet. The properties of the order will be best shown by adducing a few examples. The asclepias, one of the genera of this order, furnishes numerous species which are said to be confined to the eastern side of North America. This genus gives origin to the name of the order, and is valued for the beauty and hardiness of most of its species. The infusion of the root of the *Asclepias decumbens* excites a general perspiration without raising the heat of the body much, and it is used in Virginia in cases of pleurisy or inflammation of the membrane lining the chest. It has also purgative properties, and has been administered in dysentery.



ASCLEPIADEÆ. *a*, flower; *b*, vertical section of the same magnified; *c*, fruit; *d*, horizontal section of the same; *e*, apparatus of the pollen; *f*, seed.

The root of *Asclepias tuberosa*, the butterfly-weed, a plant found in the United States, is also used both as a diaphoretic and purgative. The *Asclepias curassavica* acts as an emetic. The root of the *Asclepias gigantea*, or *Calotropis mudarii*, a native of Bengal, when well washed and dried furnishes a substance called mudar, which is a powerful sudorific, and has been used, more especially by the native practitioners in India, in cutaneous and glandular diseases as well as in rheumatism. A peculiar principle, *mudarine*, has been found to exist in it, which differs from other known substances in gelatinising by heat and becoming liquid on cooling. The *Asclepias Syriaca*, Syrian dog's-bane, is poisonous to dogs, and also to man. It yields a resin, and a considerable quantity of caoutchouc. It is furnished with appendages to the flower which act as fly-traps. The young shoots when boiled become esculent, and taste like asparagus. The application of heat in this instance, as in many of the apocyneæ, deprives the plant of its poisonous qualities. The *Asclepias lactifera* furnishes abundantly a sweet milky fluid which is used as food by the Indians. The fibres of the stem of the *Asclepias debilis* are made into a sort of flax, which has a rich gloss and possesses great strength.

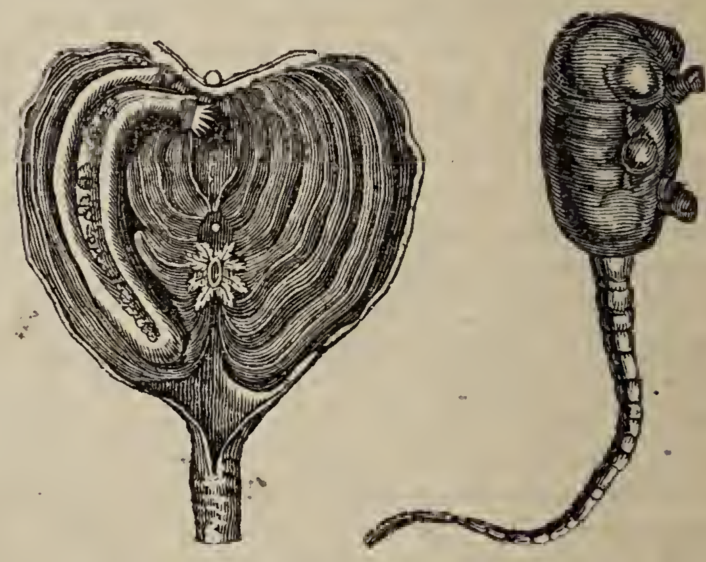
The *Cynanchum*, another important genus of this order, grows in northern latitudes. It is said, however, to extend from 59° north latitude, to 32° south latitude, a wider range than that usually enjoyed by individuals of the vegetable world. The roots of *Cynanchum vincetoxicum*, swallow-wort, tame poison, have a nauseous odour and a bitter acrid taste, which are lost by drying. They excite vomiting and purging. The *Cynanchum monspeliacum* furnishes a strong purgative concrete juice, known in commerce as the scammony of Montpelier; while the Smyrna scammony is furnished by the *Periploca scammonis*, another plant of this order. The leaves of the *Cynanchum oleæfolium*, or argel, found in Nubia and Egypt, are often mixed with those of senna; they possess similar properties with the latter, but are apt to be too powerful and cause colic. The *Cynanchum ipecacuanha*, a native of the Isle of France and Bourbon, and called sometimes, from its properties, *vomitorium*, has an acrid bitter root which is used as a strong and active emetic. It is one of the species of white ipecacuan.

The stapelia is a peculiar and extensive genus found in southern Africa. Its flowers are commonly coloured, and have an offensive odour, while fleshy stems supply the place of leaves.

The *Gymnema lactiferum*, a plant found in Ceylon, called by the natives kiriaghuna (from kiri, milk), yields a nutritious milky juice, like the cow-tree of the Caraccas, or the milk-tree of Demerara.

The genus pagularia is esteemed for the fragrance of its species. The young shoots of *Pagularia edulis*, as well as those of *Periploca esculenta*, and *Asclepias aphylla*, are used for food. *Ceropegia* is valued for its singularity. *Hoya*, is a climbing genus which, from the clustered odoriferous waxy flowers of many of its species, and the honey which they distil, must be familiar to all who are in the habit of visiting green-houses.

ASCIDIA (Linnæus, Lamarck). The body of this molluscous animal is oval, conical, or cylindrical; sometimes club-shaped. It is contained in an external envelope, more or less coriaceous, or subgelatinous, fixed by its enlarged or pedunculated base, and posteriorly terminated by two short siphons, indistinct and unequal, whose orifices are internally furnished with radiated tentacula, but slightly salient. This genus is divided into three :—first, such as have no very definite form—rugose, coriaceous, and but little or not at all extensible, of which the *A. microscomus* is an example; the second possesses a soft skin, flexible, and more or less extensible, *A. intestinalis*; and the third oval, regular, with a more or less elongated peduncle, *A. clavata*.



Ascidia Australis.

The species of this genus amount to thirty-three, according to Gmelin; but Lamarck only enumerates twenty-two. They appear to inhabit every part of the ocean, but particularly the Northern Seas, where they live attached to submarine bodies, frequently at a great depth. It is extremely difficult to distinguish their species.

Their classification, in De Blainville's system of Malacology, is seen by a reference to the article ASCIDIACEA.

ASCIDIACEA (Linnæus and Lamarck). These small marine animals are enveloped in an immoveable gelatinous, or coriaceous case, more or less rough and contractile, adhering or fixed by the reversed buccal extremity, free and terminated at the other extremity by two indistinct mammillary tubes, each pierced with an orifice, often papillary, and more or less approximated ; the larger and most elevated leading into the bronchial cavity, at the bottom of which is placed the mouth, and the other in the common tube at the termination of the intestinal canal, and to that of the other organs, the reticulated branchiæ lining the branchial cavity.

De Blainville forms of the Ascidiacea his first family of the order *Heterobranchiata*, class *Acephalophora ;* he observes, that to understand the relation existing between the animals of this family and the *lamellibranchiata acephalophora*, it is only requisite to compare them with the last genera of that order, which are constantly in a vertical position ; the buccal extremity beneath, and the anal uppermost ; the hard and coriaceous envelope of the ascidia is analogous to that which covers the body, and particularly the tubes of the truncated mya. The two short tubes which terminate it, and even the papillæ, more or less internal and radiated, sometimes observable, are also found in the little bifurcated extremities of the united siphons of the mya and some of its congeners ; the muscular part of the abdominal mass has disappeared, as not being of any more use ; the mouth is in the same position, but without labial appendices, and the branchiæ are, in fact, in the same place as in the last lamellibranchiæ, namely, in the tube itself, but their form is quite different. As to the form of the stomach, liver, heart, and even the other organs, it is evident there is a very great analogy of structure and of position.

ASCOMYS. A genus of *Rodentia*, or gnawing animals, of which there is only one known species. It belongs to the great natural family of rats and mice, and is about the size of the common rat. It has four grinding teeth on each side of both jaws, in the form of compressed prisms, the first double, and all the others single. The incisors in the upper jaw are marked by two furrows in front. There are five toes on all the feet, and the three middle ones in front have very long and crooked claws, flat on their under sides, and well-adapted for digging in the ground. It has large cheek pouches, which give a singularly thickened appearance to the sides of the head and the upper part of the neck ; and on account of these, some authors have called it *mus bursarius*, or the pouched mouse ; but as the term " pouched," when applied as part of the general description of an animal, usually refers to the existence of a *marsupium*, or abdominal pouch, in the female, the general use of the word in any other way is exceptionable. This animal is very low on the legs, but it is an expert digger, and lives in very deep burrows. Its haunts are the uninhabited parts of the interior of North America ; and its food is understood to be vegetable.

ASCYRUM (Linnæus). A genus containing five species of North American, chiefly green-house, shrubs. Linnæan class, and order *Diadelphia pentandria*, natural order, *Hypericineæ*. Generic character : calyx of four sepals, the interior largest ; corolla four-petaled ; stamens variously united at the base ; styles three, sometimes only one or two ; capsule one-celled, three-valved ; valves bearing the placenta on their margins.

ASH-TREE. The *Fraxinus excelsior*. One of our most common and useful trees. Linnæan class and order *Polygamia Diœcia ;* natural order *Oleinæ*. Generic character : flowers polygamous ; calyx four-parted or none ; corolla of four petals, four-parted or not ; stamens short ; anthers ovate, two-celled, opening outwards ; stigma almost sitting, divided ; fruit two-celled, compressed, winged at the top, often one-seeded.

The Ash Tree.

The ash, from its long standing in Britain, may be considered a native. In favourable soils it grows to a large size before it is rotten at the core ; and its timber stands next in value to the oak. For all kinds of agricultural implements it is preferred ; and for every purpose where pliability and toughness are required it is inestimable. Whether grown for timber or underwood, no tree answers the purpose of the planter better than the ash. It is, however, injurious to all undergrowths ; its numerous roots run near the surface, and exhaust the soil so much, that neither corn nor grass prosper under its shade. For this reason the tree is unsuitable for hedge-row timber, and should always be, whether intended for timber or coppice, sown or planted by itself.

Cultivation.—The seeds may be sown on fresh mellow loam, in beds, either in autumn, as soon as they are ripe, or kept in dry sand during winter, and sown in April. Most of the autumn sowed seeds appear in the following summer ; and many seedlings of the spring sowings do not rise till the following spring. After standing twelve months in the seed-bed, the seedlings may be transplanted into nursery rows, twelve inches apart, to gain strength, before being finally put out in plantations. Underwoods may be raised by sowing the seeds on clean, well-prepared ground, like a crop of corn ; by which means they seldom fail to succeed. Ash coppice may be cut every seven years for hoops, hedging stuff, &c. ; and every tenth or twelfth year for hop-poles, hurdles, and other fencing materials.

There are above forty species of this tree; and of the common ash there are ten varieties seen in arboretums, or in ornamental plantations. Among these the *F. excelsior pendula* is one of the most curious, the branches running on the surface of the ground instead of rising in the air; but by grafting a scion of the *pendula* upon a tall stem of the common, the branches from the scion hang downwards: hence it is called the weeping-ash.

The Manna Ash (*Ornus rotundifolia*), a native of Calabria, yields the gum called manna; and is mentioned in this place because the tree is erroneously called an ash, though, in fact, it belongs to another genus, which will be noticed in course.

ASIMINA (Adanson.) A genus of four species of deciduous shrubs, natives of North America. Linnæan class and order *Polyandria Polygynia;* natural order *Anonaceæ.* Generic character: calyx three-cleft; corolla of six petals, the anterior smallest; stamens numerous, inserted on the disk of the germen; anthers somewhat sitting, and nearly united; style somewhat ternate; berry egged, fleshy, sitting closely, and full of seeds. These plants being tender are seldom seen in European collections.

ASIPHONOBRANCHIATA. The second order of the class, *Paracephalophora* of De Blainville's System of Malacology.

In these animals the organs of respiration are constantly formed by one or two pectiniform branchia, obliquely placed on the anterior part of the back, and contained in a cavity, the upper division of which is not prolonged into a tube, but which sometimes presents an appendage, or inferior lobe, performing that office.

The shells of this order vary considerably in form; the aperture is constantly entire, and always completely operculated, that is, closed by a horny, but more frequently a calcareous operculum, proportioned to the size of the opening. The name of the order means literally, not possessing branchial siphons.

ASPALATHUS (Linnæus). A rather extensive family of evergreen shrubs, from the Cape of Good Hope. Linnæan class and order *Monadelphia Decandria;* natural order *Leguminosæ.* Generic character: calyx five-toothed, teeth rather unequal; standard clawed, keel divided; pod oblongly-egged, denuded. There are above thirty species of this genus, all of which are more or less ornamental. They are arranged in two divisions, viz., with leaves in bundles, and leaves trifoliate. The scenery of southern Africa is much enlivened by the flowers of this tribe of plants.

ASPARAGUS (Linnæus). A genus of twenty-six species of herbaceous or low shrubby plants, found in almost all parts of the world. Linnæan class and order *Hexandria Monogynia;* natural order, *Asphodeleæ.* Generic character: corolla somewhat bell-shaped, six-cleft, deciduous; stamens inserted in the base of the corolla; filaments awl-shaped; anthers erect, inversely heart-shaped; style short; stigma three-lobed; berry globular, three-celled, containing seed.

Asparagus has been long in cultivation, and esteemed one of the most delicate productions of the kitchen-garden. In its wild state on the sea shore the whole plant is diminutive, but is capable of considerable amplification by suitable culture.

The physical structure of the plant requires to be well understood, in order to have right ideas of its manner of growth and requisite management. The root, from its peculiar form, affects an open, porous soil; it being a much divided tuber, its divisions extend horizontally, and are furnished with fibres along their whole length. The divisions are attached to and meet together on a collet or crown, whence the shoots arise. The crown is annually enlarged by offsets, which usually proceed from the first in one direction; the first formed crown and appendages consecutively dying off as new divisions are produced. Although the crown, after three or four years, be composed of an aggregation of distinct plants, yet they are not independent of each other, because when united they produce much stronger shoots than any one of the divisions could do if separated; therefore it is a rule in the management of the plant to allow the crown and roots to accumulate and gain strength for three or four years before they are checked by the knife.

To give luxuriance to the whole aggregation is the special object of the cultivator; and whether he sows or plants his asparagus, he must consider that it is not from the seeds or plants which he so carefully puts into drills that he ever should or ever can gather a crop of shoots, but from the new offsets produced from the originals.

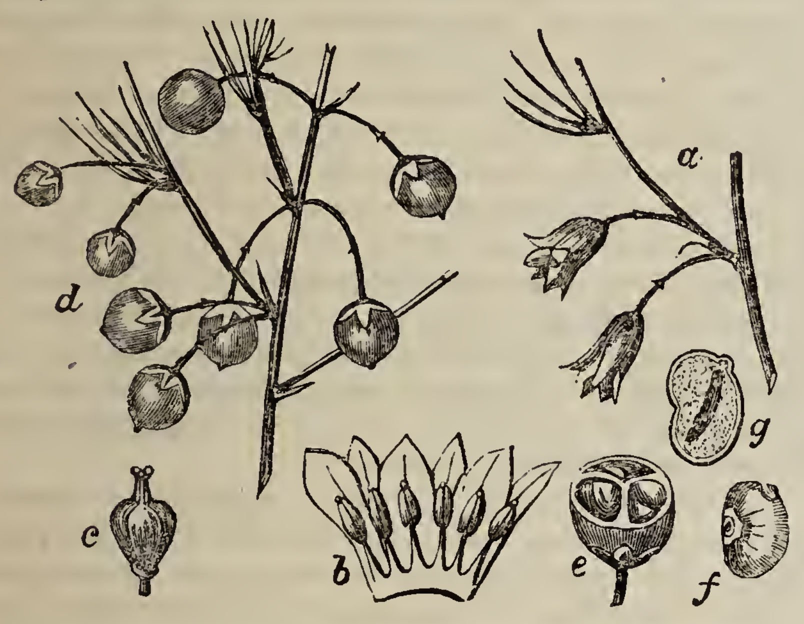
To encourage, and even pamper the plant, by every practicable means, constitutes the art of culture. For this purpose the soil should have a light, friable surface, with a rich substantial bottom, or subsoil. To form such a bed, the usual practice is to bury by trenching (fifteen inches deep) a thick coat of the richest dung that can be procured; not that it is expected the roots will ever descend so deep, but that such a sunken stratum of rich material will be retentive of moisture, and will also be ever evolving a nutritious gas serviceable to the plants. The new surface should also be enriched by a good coat of well-rotted stable dung, leaf-mould, and sea-sand, if it can be conveniently had. All this well incorporated by the spade, and freed from stones, levelled, &c., will be in condition to receive seed or plants.

Although a plantation of asparagus may be laid down by sowing seeds, it is seldom so executed, because much time is lost in waiting till seedlings acquire the necessary strength to produce shoots of a proper size. A better plan is to prepare a seed-bed previously to transplant from, or purchase two-year old plants from a nursery-garden.

The ground should be completely ready for planting any time in the month of March. The first step is to divide the surface into beds of two feet wide, with two-feet alleys between; or three-feet wide beds, with two-feet alleys; or into five-feet wide beds, with two and a half feet wide alleys between. The narrowest beds are intended for single rows; the next for double rows, and the last may have four rows of plants.

All plants rob each other if placed too near together. Of course single plants, or single rows of plants of asparagus particularly, grow more luxuriantly, and yield larger shoots, than when placed in closer order. But as quantity as well as quality are desirable, five-feet beds with four rows, and two and a half feet spaces between, with six-inch margins at the sides, is the disposition most commonly adopted. In first-rate gardens asparagus should always be planted in single rows; not only for the purpose of obtaining superior quality, but for another purpose hereafter to be noticed.

The business of planting is performed in two ways, viz., by drawing drills with the hoe, in which the plants are placed, spreading the roots right and left, the crowns being set against the upright side of the drill, and about two inches deep; the removed earth being afterwards drawn back over them. Another method is to remove two inches of the whole surface of the bed; in this opening the plants are set by line, having their roots spread out in their natural positions, and afterwards covered up with the removed soil. The distance from plant to plant in the rows may be nine, ten, or twelve inches, according to the size of the plants.



Asparagus Officinalis. *a*, flowers; *b*, corolla opened to show the stamens; *c*, pistil and ovary; *d*, fruit; *e*, horizontal section of the fruit; *f*, seed, magnified; *g*, vertical section of the same.

The summer management of such a plantation only consists in keeping the ground free from weeds by frequent hoeings, and paying attention that no deep-rooting perennial weeds, such as docks, dandelion, birdweed, &c., get established among the roots of the crop; for if they do, they are ever after a plague to extirpate.

It may be easily conceived that asparagus plants so treated have every chance of succeeding. The soil being open and rich gives every facility for the range of the roots, and consequent enlargement of the crowns and stems. In soils naturally rich, as the alluvial deposits on the banks of rivers, or on sands impregnated with much vegetable or animal matter, we see asparagus succeed without any other preparation than is made for other garden crops, viz., by a simple digging; and it may be safely averred that this favourite vegetable may be had without half the trouble and expense usually bestowed in laying it down. It is well, however, to err on the safe side; and wherever planted as above directed no fears need be entertained of success.

To protect and strengthen the roots, it is an old custom to cover the beds about the beginning of November with short dung two or three inches thick, above which is laid a coat of earth dug out of the alleys. This is supposed to save the roots from frost, and feed them with the juices washed down from the covering of dung. The latter idea is good; but the former is groundless, because no roots are more hardy than those of asparagus. Still a winter covering is useful, not so much for the defence of the roots, but for another reason not always appreciated. In early spring the temperature of the earth at twelve inches from the surface is always higher by ten or fifteen degrees than the air; consequently, roots lying at that depth are sooner excited into action than such as are just beneath the surface; it follows of course that the shoots are ready to rise as soon as the season permits the removal of the covering, viz., about the 20th of March. In this view, and for the purpose of bringing forth the shoots, a covering is necessary, and the thicker it is, the more care is necessary in forking the beds when they are levelled down at the spring dressing, lest any of the points of the shoots are broken by the fork.

The author of this article has long disapproved of this method of spring dressing asparagus beds. Many of the crowns and roots are injured by the tool even in the most careful hands, if put deep enough; and if it be not allowed to go deep enough to break the old surface, it answers very little purpose doing such work at all. A safer method of winter management is this:—As soon as the stems are dead in the autumn, let them be cut down close to the surface and cleared away. Then let the beds be forked over as deeply as may be without disturbing the roots. At this time there is less danger of damaging the crowns because their places can be seen by the remains of the old stems. The surface being thus sufficiently broken, the beds should be covered with at least four inches of old hot-bed or other exhausted dung. Over this may be laid a couple of inches of mould raised from the alleys, and so to remain during winter. This mould is only to be raked off at the spring dressing, leaving what remains of the dung to form the surface, through which the shoots will easily rise, and which is turned in and mixed with the common soil by the fork at the autumn dressing. Supposing the crowns to be at their natural depth from the surface, viz., two inches, and the covering of decayed dung to be two inches more, these together will be a depth sufficient over the crowns to allow length enough of shoot to be cut for use. The advantage of this annual addition of soft mild dung, is its being gradually reduced to a fine fertile mould, particularly well calculated to allow the shoots to penetrate and to yield suitable nourishment to the roots below.

As asparagus plants are much weakened by cutting the shoots before they are well established in the ground, it has become a rule to reserve a new plantation till the third year after it is laid down before any shoots are cut, and even then it is done but sparingly. One shoot from each plant is considered quite enough to be taken in the third year; on the fourth a fine and plentiful return may be expected; and in every following year, if the cutting be done regularly and moderately, a plantation will continue productive for many years, provided care be taken to fill up any blanks that may occur in the beds by the introduction of fresh plants. The long period that this crop keeps, or may keep possession of the ground, is the reason why so much manure is buried beneath the plants in the first place. Manuring afterward can only be applied in the shape of top dressings; and though this may be administered effectually in the case of many surface rooting plants, it is well to have a rich sub-soil for plants intended to remain many years on the same spot.

It has been before observed, that the natural depth for the crowns of the asparagus plant is two inches; and if two inches more be given of artificial covering, shoots allowed to rise four inches above the surface will be the required length for the table. It is the exposed part of the shoot which is eatable; as the white or bottom part produced within the ground is too tough and stringy for use. The shoots, however, may be drawn to a much greater length by extra coverings of any loose substance, as dry peat earth or leaf mould.

The shoots when ready for use are cut with a saw-edged knife, or broken off from the crown by the finger. When the crowns are deeply covered, the knife must be used; but when they are only hidden by two or three inches of loose and easily removed earth, the shoots may be forced off with the utmost facility. In both ways there is danger of damaging the rising shoots if care be not taken in the execution, and certainly less by the knife than by any other means. When cut, the shoots are tied in bundles of quarter, half, or whole hundreds, before they are carried to market.

Asparagus is extensively forced both in private and market gardens, and usually on dung heat. It may also be forced in glass covered pits, by either hot water, steam, or fire flues.

The principle of forcing such a plant as this, is to do it gradually; because, being taken from their native bed, where they have been for years established, and placed in a situation with which they have no previous connexion, they must depend on their own innate vigour or store of nutriment within themselves, to enable them to produce shoots from their incipient buds. Excitement is almost all they receive in their new place; and, therefore, unless they are substantial and in high health, the shoots produced will be few and diminutive. It is for this reason that full aged plants are chosen for forcing, viz., four or five years old from the seed-bed.

Hot-beds for asparagus are made of well prepared stale dung, and more or less substantial, according to the time of the year in which forcing is begun. If wanted for the table in February and March, the bed should be made about Christmas, and not less than three feet in height. When the heat has risen and become moderate, the frame and lights being put on as soon as the bed is made, the surface should be laid so as to be about one foot from the glass, and covered with about five inches of dry loose earth. On this the plants are laid in rows as closely together as possible, filling the openings between the crowns and roots with light dry compost (sandy loam and leaf mould is the best), and covering the whole therewith to the depth of two inches. The steaming heat from the dung will soon make the compost and roots moist enough; but if very dry, a sprinkling of water may be given at planting.

As soon as the shoots appear through the surface, two more inches of compost must be put on; and after they have risen through this, another covering of the same depth must be added, which finishes the earthing up. The purpose of this gradual earthing up is to accelerate the growth of the shoots, and to prevent burning the roots, which, were the whole covering put on at once, would be likely to happen. After this last addition of compost, the frame and lights will require to be raised three or four inches by placing bricks under the corners, and thick twisted straw bands along between to prevent the earth falling out from under the frame. Some practitioners think it better to fill the frame in the first place, so that the roots should be no more than six inches from the glass, and, as the shoots rise and require earthing up, to raise the frame at the same time, so that the shoots shall always be as near the air and light as possible. After the final earthing, the shoots are allowed to rise towards the glass, and then to have as much air and light as can be with safety admitted, because it is these which give colour and flavour.

In the course of this method of forcing asparagus, care must be taken that the heat is never at any time too intense. If the dung has been duly prepared by repeated turnings before made into a bed, there is less fear that it will heat violently afterwards, unless it be too thickly covered with mats, or not sufficient air be given to allow the heat to escape. Very severe weather may be expected, and attention must be paid lest the bed gets chilled. Sharp frost is kept off by surrounding the bed with dry litter and coverings of mats; and, if needful, by hot dung linings rather than the roots be checked by cold. But at all times a temperate rather than a strong heat is required, because the stronger the heat, the smaller and more worthless are the shoots, and their running spindlingly up can only be checked by admissions of fresh air whenever the weather allows. Such a bed successfully forced, continues to yield moderate dishes of asparagus for three weeks or a month after the first shoots are ready to cut.

Asparagus may be also forced in pits built for the purpose, in which there must be a full command of heat, whether by fermentive substances, as tanners' bark, stable dung, or leaves; or by heat, given out by steam or hot water pipes, or smoke flues. The roots should be planted as near the glass as possible, so as to allow space for earthing up and growth of the shoots.

Asparagus planted in single rows on two-feet wide beds may be forwarded in the open air by having the alleys between dug out to the depth of sixteen or eighteen inches, and filled with hot dung or leaves. For this special purpose the sides of such beds are formed of boarding or open brickwork. By this expedient, fine shoots may be had a fortnight or three weeks sooner than they can be had naturally; and as it is only exciting the growth a little earlier than would happen without the application of the heating substance, there is no destruction of the plants. As the full effect of this mode of forcing cannot be had without some kind of covering on the surface, a rank of hand glasses should be employed, and these covered in the night to protect from frost, are all that is wanted. Such narrow beds can only be forced in this manner; but the same should not be forced two years together, as this would tend to weaken the plants too much. The same beds, however, might be forced every third year without injury; and where such practice is intended to be followed, a sufficient number of such beds should be provided.

ASPERGILLUM (Lamarck). SERPULA AQUARIA (Linnæus). In separating this shell from the Linnæan Serpula, Lamarck has been guided by the presumed distinct organisation of the animal, and though the inhabitant is unknown, the different structure of its shell fully authorises his having distinguished it from the Serpula and his constituting a new genus of it.

This singular formed shell is a testaceous tube (Lamarck calls it a testaceous sheath), somewhat curved, though in most instances nearly straight; it gradually tapers towards, and is open, at the upper extremity, becoming rather club-shaped towards the lower end, which is closed by a convex disk, or cover, perforated by numerous small holes, from whence it derives its trivial name of the *watering pot;* in the centre of these a small lengthened fissure is observable; it has a waved sub-tubular fringe-like border, and occasionally two, projecting beyond the periphery of the outer circle. On the side of the tube, near its extremity, are two permanently fixed valves, leaving an open fissure between them, and the exterior of the tube of some species is incrusted with sand.

Lamarck considers this shell an *equivalve bivalve,* allied to the genus *Fistulana,* in which, however, the shell it includes is detached and free, while in the *Aspergillum* it adheres to the sheath, completing, by the two fixed open valves, a part of the tube that encloses the animal. He remarks that it is, no doubt, an error to imagine the shell ever fixed by the open end, which, like the fistulana and clavagella, must of necessity be open to permit the animal's egress. De Blainville observes, that this mollusk probably covers but a small portion of the animal's back, upon which it is, no doubt, attached: he describes two species: the first, *A. Javanum,* which possesses a fringed disc (we may say sometimes more than one); and the second species, *A. Novæ Zeylandicæ,* which is without that fringe, or frill. He adds that, notwithstanding the resemblance between these two species, it is extremely difficult to form an idea of the inhabitant of the aspergillum, and, above all, of the organs which penetrate and form the tubular spines of the disc, without we assume them to be the filaments of a sort of byssus, or of the foot itself, serving to attach the mollusk to submarine bodies; we might then admit of its existing in the sand, attached to a great number of its grains, in a position more or less vertical, the smaller extremity of its tube uppermost, and the head downwards. In his system of Malacology, he has ranged it in the second section of the family *Pyloridea,* the order *Lamellibranchiata,* and class *Acephalophora,* immediately following the genus *Clavagella.* Recent species inhabit Java and New Zealand. De France also enumerates two fossil species. Though this mollusk does not possess any brilliant hue to attract the eye, or a form particularly symmetrical, it is, nevertheless, highly interesting to the naturalist, and has given rise to much speculative reflection, which time alone will satisfactorily elucidate.

ASPHALTUM, or compact mineral pitch, an inflammable resin, which appears to form one of the connecting links between the vegetable and mineral kingdoms. It is of a shining black colour, and breaks with a conchoidal fracture.

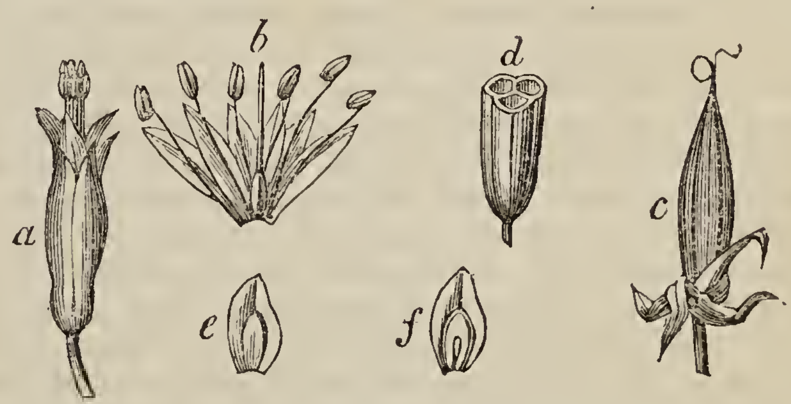
Asphaltum occurs in veins, in secondary limestone, in Fifeshire, and in several other parts of Scotland. The continent of Europe also furnishes great quantities; but Asia and America are the main sources from whence it is derived. It rises in large masses to the surface of the lake Asphaltes, in Judea, and appears to be derived from strata of mineral pitch in the neighbourhood. In the island of Trinidad there is a lake three miles in circumference covered with this mineral, and considerable quantities are brought from Barbadoes. It may be proper to add, that in various parts of the world we find a species of natural unctuous and inflammable substance oozing from the earth, which, under the various names of naphtha, petroleum, earth pitch, and asphaltum, is found of considerable service in the useful arts. The Egyptians formerly employed it for embalming the bodies of the dead; and the Turks still use it, mixed with common resin, for coating the rigging of their ships. The mineral pitch of Trinidad is supposed to have the power of protecting the hulls of vessels from the attacks of the teredo or borer, so frequent in the West Indian seas. See PITCH, MINERAL.

ASPHODELEÆ. A natural order of *Monocotyledonous* plants containing upwards of fifty genera and more than 500 species. It is allied to the lily tribe, but differs from it in its expanded flowers, and dark crustaceous, fragile seed-coat. The essential characters of the order are: calyx and corolla six-parted, or six-cleft regular; stamens six, inserted on the perianth; ovary free, three celled, and generally containing numerous seeds; one style; stigma entire or three-lobed; fruit usually a three-celled capsule.

The plants of this order are generally herbaceous; occasionally, however, they are arborescent. They are all pretty; many of them are showy and ornamental, and as such cultivated in gardens. The flowers are coloured and the roots are bulbous or fasciculated. They are widely diffused over the globe, and are found much more abundantly in temperate than in tropical climates. Some of them grow in the colder regions of the earth. They form a marked feature in the vegetation of New Holland.

Their properties reside in their roots, or bulbs. In general they are bitter and stimulating, sometimes acrid. In many instances they contain much starch, and then are nutritive. None of them are poisonous.

In order more fully to exhibit the properties possessed by the plants of this family, it will be necessary to notice a few of the more important genera included under it.



PHORMIUM TENAX. *a*, flower; *b*, the same opened to show the stamens; and pistils *c*, fruit; *d*, horizontal section of the same; *e*, seed; *f*, the same in section.

From the *Phormium tenax,* represented in the preceding figures, there is prepared the strong fibrous New Zealand flax, which, from its superiority to all other kinds of flax, has now become an important article of commerce.

The genus Asphodelus, whence the order derives its name, contains many showy species which contribute not a little to adorn our flower-gardens, but none of which are put to any particular use.

The extensive genus Aloë is found in this family. It consists of succulent plants provided with thick firm leaves, which absorb powerfully by the surface. The purgative substance commonly known by the name of aloes is obtained from several species of the genus. There are three kinds of aloes imported into this country, viz. the Socotrine, the Barbadoes, and caballine aloes. The first is procured from the *Aloe Socotrina,* or spicate, and was brought formerly from the island of Socotra at the entrance of the Red Sea. It is now procured from the Cape of Good Hope and from the island of Jamaica. The second is called also hepatic aloes, from its resemblance to liver, and is procured from the *Aloe perfoliata*. It is not quite so pure as the first, and is imported from the Levant and the island of Barbadoes. The third variety, called caballine, or horse aloes, differs from the others in being very coarse and impure, and in exhaling a very fetid smell. It is said to be the refuse of the process for making Barbadoes aloes, and is only used in veterinary medicine. Aloes is a stimulant purgative, and acts chiefly on the lower part of the intestines. It is prepared either by cutting the leaves of the plants and allowing the juice to flow out, or by boiling them in water and afterwards evaporating. The purest or Socotrine aloes is got by the former method.

Allium is another important genus of this order. The leek, onion, shallot, chive, rocambolle, and garlic are all species of the genus. In general they are stimulant, and are used as condiments to promote digestion and excite the appetite. Garlic, or the allium sativum, besides being an ingredient in the epicure's sauces, is employed medicinally as a powerful diffusible stimulus. It is also administered in cases of retention of urine. The onion (*Allium cepa*) was worshipped as a divinity by the Egyptians. It contains a volatile oil combined with sulphur, and has been used in dropsy. Most of the alliums act as rubefacients, and some of them as blisters.

The genus *Scilla* possesses properties in many respects similar to those of the allium. From the large scaly root of the *Scilla maritima*, a plant which grows on the sandy shores of the Mediterranean, a medicinal article is procured, known by the name of squills. This is a bitter stimulant substance, which is very extensively used. It acts chiefly on the lungs and kidneys, possessing expectorant and diuretic virtues. It also acts in large doses as an emetic. From its stimulating qualities, it cannot be employed in any active inflammatory complaints. Squill root contains an acrid principle, called scillitine, which is volatile; and hence it loses by keeping or too much drying. The inhabitants of the Pyrenees use the bulb of the *Scilla lilio-hyacinthus* as a purgative. The roots of the *Scilla esculenta*, esculent squill, or camass, are eaten by various Indians on the North-west coast of America; and a kind of cake is made from them.

The common asparagus, which in its young state is a delicate article of food, is used as a diuretic, and is said to exert a peculiar sedative effect on the heart's action. The shoots of most of the species, even of those which afterwards become woody, may be used as food in their young state. The long fleshy roots of the *Asparagus sarmentosus* are eaten with milk by the inhabitants of Ceylon. An extract is procured from the roots of many of the species of asparagus, and a crystalline matter denominated asparagin.

The *Dracæna Draco* yields a concrete juice, called gum dragon, which is used as a styptic, to stop bleedings and discharges. The *Dracæna terminalis* is diaphoretic, and its root is used in Java in dysentery. *Ti*, a favorite spirit of the Sandwich islanders, is prepared from this plant. Several gigantic species of *Dracæna* are found in the Canary Islands.

Xanthorrhœa hastilis yields the yellow gum resin of New South Wales. In consequence of its spiral leaves hanging down on all sides, this tree is called by the English inhabitants of Port Jackson, the grass-tree. It is used as a styptic and anti-dysenteric.

The thick tuberous roots of the *Yucca gloriosa*, Adam's needle, have been used by the Indians in place of bread.

The root of the *Ornithogalum umbellatum*, common star of Bethlehem, which is eaten to the present day in Palestine, is said to be the *dove's dung*, mentioned in the Second Book of Kings, chap. vi., v. 25. The fragrant flowers of *Ornithogalum corymbosum* are used by the Peruvian females as an article of ornament for the hair.

We might have noticed the Hyacinth and several other beautiful genera, belonging to the Asphodel family, were it not that those already alluded to are sufficient to show the properties of the order.

ASPHODELUS—Asphodel (Linnæus). A family of ten species, herbaceous flowing perennials, natives of Europe. Linnæan class and order *Hexandria Monogynia*; natural order *Asphodeliæ*. Generic character: corolla six-petaled, spreading; stamens, filaments form a vault with the base of the petals, connected, arched, awl-shaped; anthers incumbent; style awl-shaped, bending upwards; capsule leathery, three-celled, full of seeds; seeds angular. These plants always find a place in the shrubbery borders, as they are of rapid growth, and flower readily; they are also easy of propagation by division.

ASPIDIUM (Swartz). One of our most numerous and beautiful families of Ferns. It is called the shield fern, from the form of the indusium of the fructification. The genus consists of forty-eight species, of which thirteen are natives. Generic character: sori, roundish and scattered, or deposited in ranks; shields solitary, roundly peltate, or kidney-shaped, fixed by the middle or the edge. Cryptogamists have arranged the genus into five sections, founded on the forms of the fronds, viz. ternate, pinnate, bipinnate, bipinnatifid, and supradecomposite.

ASPIDOPHORUS, a genus of spinous-finned fishes, belonging to Cuvier's family of *Joues cuirassées*, or those which have the cheeks armed with thick and strong scales, or osseous plates. The fishes of this genus have not the cheeks only, but the whole body and tail so armed. They have also the gill-covers bordered with fleshy filaments. The mouth opens under the muzzle. They have not teeth in the *vomer*, and by this they are distinguished from the bull-heads (*cottus*), with which at least some species of the present genus have been confounded. The scales with which the body is covered are large and angular, and thick and tuberculous in the middle. They have in general two dorsal fins.

There is one species which is met with on most of the coasts of Europe, the common pogge, or armed bull-head. It has the head large, the plates upon it also large, forming a complete armour; four small spines on the snout; and the fleshy fibres of the gill-covers so long as to hang like a beard under the throat. It is a small fish, seldom met with more than four or five inches long, and in an economical point of view it is of no value.

There are other species, chiefly in the Pacific Ocean, some of which differ in one respect or other from the pogge; as, some have the mouth in front, and the two jaws of course equally produced; others have the gill-covers smooth; and there is an Indian species with but one dorsal fin, which Lacépède has, apparently without much reason, formed into another genus, *Aspidophoroides*.

ASPLENIUM (Linnæus). A family of ferns consisting of forty-seven species, natives of almost every region of the earth. Generic character: sori in lines along the sides of the veins; indusium, a membranous plane, opening at the side. This tribe is divided into six sections, founded on the form of the fronds.

ASPREDO. A genus of soft-finned fishes, with abdominal fins, belonging to the natural family of the *Siluridæ*, and by the elder ichthyologists included in the genus *Silurus*. They have one remarkable character, not to be met with in any other of the bony fishes, and yet in which they can hardly be said to approach the cartilaginous ones. Their gill-lids are immoveable, and there is merely a slit on each side of the neck, by means of which the water used in respiration is discharged after it has passed through the gills and performed its office there. The gill-lid is incapable of motion; and thus it is a question how they contrive to produce a current of water through the gills when they are at rest, as the motion of the gill-lid is supposed to assist in that operation in all the other bony fishes. Their head is flat, and the eyes very small and placed in the upper part of the head. The anterior part of the body is much enlarged, especially in breadth. They have two teeth or spines upon the first ray of the pectorals, much larger and more formidable than those on any of the siluri. There is but one dorsal fin; but the anal fin is long, extending to the tail, and the tail is slender as well as long. As is the case with that of most of the family, their flesh is little esteemed.

ASPRO. A genus of spinous-finned fishes, so called from the roughness of their scales. They belong to the *Percoidæ* or perch family, and in many of their characters they have a considerable resemblance to the common perch. The leading characters are,—the body elongated, with two dorsal fins considerably apart from each other, and with the ventral fins very large; the head is depressed, and the muzzle projects beyond the mouth, and is rounded at its termination.

Two species are found in some of the rivers of Europe; but so far as observation has gone, they are not generally distributed even where the latitude and climate are nearly the same. The flesh of both is esteemed as pleasant to the taste, and light and easily digestible.

One species, *l'apron* of the French, is found in the Rhone and its branches. It is the *Aspro vulgaris* of Cuvier, and *Perca asper* of Linnæus. It is of a greenish colour, with three or four vertical bands of black upon each side. It grows to about the same size as the common perch, only it is longer in proportion. This species has eight rays in the first dorsal fin.

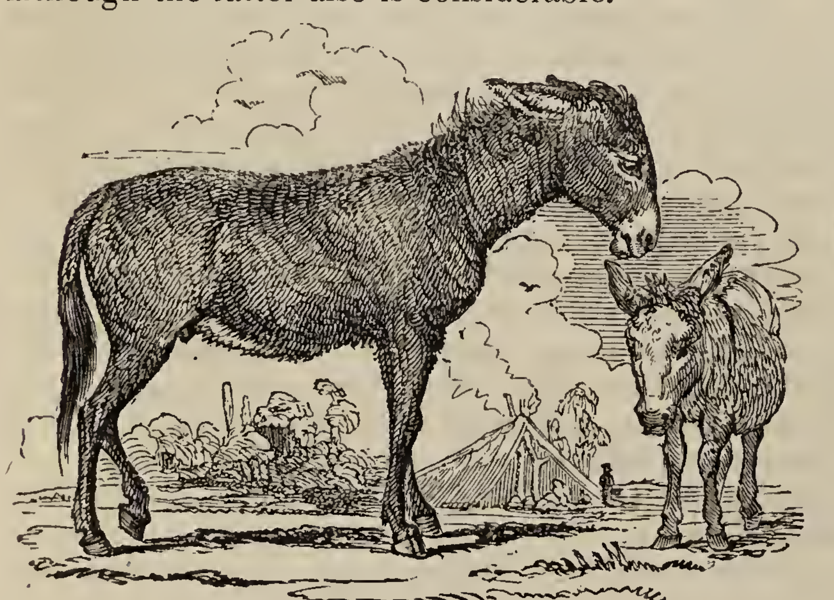
The other European species is found in the Danube; it is the *Zingel* (*Perca zingel*) of Linnæus. It is larger than the other, but coloured nearly in the same manner. It has thirteen rays in the first dorsal fin.

ASS (*Equus asinus*), a well-known, but, in this country at least, not equally well-used animal. It is a species of the genus *equus*, or the horse, and intermediate between the horse, properly so called, and the zebras or striped species of the same genus. The genus forms the third family of Cuvier's *Pachydermatous* animals, the family *Solidungula*, that is one-hoofed or solid hoofed. Attempts have sometimes been made to make the ass a genus separate from the horse, but they have, very properly, not been generally adopted. There are *specific* differences certainly, but there is not one *generic* one: and the same law of subdivision, which would make two genera of the horse and ass, would, if carried generally into natural history, destroy the foundation of all generic classification. The discovery of a new genus is however reckoned so very great an honour among systematic naturalists, that it is no wonder that some of those who have not the opportunity of discovering a new genus, should be occasionally tempted to "do the best they can," by making one. The present instance is, however, far from a happy one for such an experiment.

In this country, the ass is seen under very great disadvantages, and, independently of the climatal deteriorations, and the greater deterioration arising from bad treatment, there is a prejudice attached to the very name. Ironically, it is, in vulgar language, used to express dulness and stupidity in human beings; and this, its metaphorical meaning, is thrown back with additional degradation upon the animal. Why this should be so strongly the fact in the case of the ass, does not appear explainable upon any very rational grounds, as it is not so in the case of some other animals. Thus, to call a man "horse," is neither very consistent with polite speech, nor very complimentary; and yet that does not in the least detract from the character of the horse, which still holds its place, by common consent, and in common parlance, as "the noblest" of domestic animals. Something may depend upon the owners and the usage of the animals, though when the horse is past honourable and respectable service, rating the treatment according to the power of endurance, he is probably the worse used animal of the two. Much as Englishmen boast of their horses, and carefully as they tend and pamper them while handsome, the pathetic ballad of "The High-mettled Racer" is still a faithful biography of perhaps ninety-nine out of every hundred horses in England. A few, no doubt, are allowed to spend their last days in ease and plenty; but they are so few that they form the exception and not the rule. The character of the animals appear, however, to be taken from the condition of their owners, and the treatment which they receive in their best service, and thence may arise the difference.

The ass, from its low price, the cheap rate at which it can be maintained, and its exemption from state imposts is, in an especial manner, the poor man's beast of burden. But the state of modern society in Britain is such, that the more settled, constantly occupied, and, for these reasons, the more respectable of the poor, do not require beasts of burden. They are almost all employed for others; and therefore the ass falls into the hands of persons of another description —those who have no home or no constant employment at home, but who must wander about the country in the profession of the lowest description of huxters, or with no profession at all. Though persons of this description cannot be said to be altogether out of society, they are of necessity deprived of many of its advantages. They get no character from the more regular part of society; and it appears to be a sort of law of human nature, that persons who are too poor to purchase a good character (for, in a mercantile country, that article has its price as well as others), are never able to acquire one, unless the world gives them some little to begin with. Such persons are necessarily without many of the wholesome restraints of regular society; and, which is of far more importance, though but too often overlooked, they are without the incentives to virtue, which are the more pleasing results of an orderly society. They are thus led, or perhaps it is more correct to say driven, to associate with each other; and it seems to be the nature of society to be progressive, whether in the gaining of character or the losing of it. Now it is chiefly to such persons and such societies that the ass belongs; and therefore he suffers, not only by the treatment which he receives from his owners, but from the opinion which, right or wrong, the world has of them. There is, of course, no moral, and except what has been stated, no social necessity, why a man who possesses, or rides, or drives an ass, should either be a man of rough character, or one who will treat the animal with cruelty; but the fact is so general, that very unequivocal proofs are necessary to restrain suspicion, even when there is not otherwise the least ground for suspecting.

These observations may, at first sight, seem to have more connection with the civil history of men than with the natural history of asses; but as we form our opinion of the animals from the condition in which we find them, it is necessary to show how they come into that condition, and that it is neither natural to them nor in any way their fault. It is true, that even the warmest part of England, even with the best treatment, is too cold for the full development of the natural appearance and character of the ass; and that, as the latitude increases, the adaptation becomes worse. But the effects of climate would not alone produce that diminution of the stature and deterioration of appearance which he has in England, as compared with the south of Europe and the isles in the Mediterranean. The contrast between the Maltese ass and the English ass is, in some respects, greater than that between the Arabian horse and the Shetland pony. (See engraving.) The bodily distinction is not so great, certainly; but that of the spirit of the animals is much greater. The pony is small in size and shaggy in covering; but there is still fire in his eye and mettle in his limbs; and small as he is, he is still "every inch a horse." The ass, on the contrary, is more dispirited than dwarfed, although the latter also is considerable.



Maltese and Common Ass.

How much, or whether any of the deterioration of the ass, in point of spirit, depends upon the circumstance about to be stated, has not been investigated; and, indeed, so far as the writer of this article is aware, the question, though it is a curious, and no doubt might prove to be an important one, has never been once mentioned by any one writer on natural history. The point is this, the ass remains far more stubbornly true to its normal type than the horse. The ass, in fact, breaks less into varieties, even varieties of colour, than any other domesticated animal. There is some reason to believe that it was domesticated at an earlier period of human history than the horse; and there is no reason to suppose that its domestication took place later. The Bible is certainly the oldest authentic history that we have; and it shows that in ancient times the ass was the general, if not the universal saddle animal for all who could afford to ride; and that the horse was used, if not exclusively, yet generally for warlike purposes only. It is not our object to institute an inquiry into the history of either animal in a domesticated state, or to trace the means or mode of their distribution from the central parts of Asia, of which it is probable that both are natives, to the several parts of the civilised world, and till the horse, at least, has become wild in the plains of South America, and the hybrid progeny of the two has become the great beast of burden, in the difficult and dangerous passes of the Andes. It is sufficient for our purpose to know that the domestication of the ass is, at least, not later than that of the horse; and that point admits of no dispute or question.

Now the horse has broken into innumerable varieties, not of colour merely, but of size, shape, and spirit; so that, not only has each country its peculiar horse, distinct, and well known to all who are acquainted with the character and points of the animal, but each small district, nay each kind of employer of horses has a marked variety. This is so palpably the case, that even the most common observer in the streets of London, who knows nothing about the economy of horses, or the preservation of the variety by "breeding in and in," or the change of it by "crossing," can at once distinguish a brewer's horse, a coal-merchant's horse, a carrier's horse, a farmer's horse, and so of all the horses which are regularly employed in a particular way, and bred for that employment. In all these, again, there are subordinate varieties, in colour, size, and various other respects; so that the horse appears particularly pliable to circumstances, whether of climate or of treatment. Many other domesticated animals, the ox, for instance, do the same, but none perhaps so readily, or to the same extent, as the horse.

But the ass shows no such varieties. There are trifling changes in the shade of its colour, and some individuals are nearly white; but the last are, from the red colour of their eyes, obviously albinos, and in the other cases, it is a simple change of shade in the colour, and not a breaking by the introduction of a new one. We do not find pied asses, or asses with a white blaze in the forehead, or white feet, neither do we find them dappled; at least if there are any such instances they are exceedingly rare. They also retain the mesial line on the back, and the transverse band which forms the cross upon the shoulders. Its coat may be sleek or it may be shaggy, according to the climate to which it is exposed and the treatment with which it meets; but it so preserves even its external specific characters, that it every where seems the very same ass, without the least tendency to variety. It is highly probable that the diminished size, and increased length and shagginess of the hair, which take place in this and in other species of mammalia, when made to reside in countries much colder than those which are natural to them, are connected with each other; and that that portion of the substance and action of the animal which, in the cold climate, goes to the production of the additional covering, would, in a more genial climate, go to increase the size and flesh of the animal.

To this law the ass yields, but still it yields as a whole; for it preserves its form even more pertinaciously than its colour. It is usually said that the ears of tame asses are longer in proportion than those of wild ones, but the fact is not very fully established. In other respects, however, the former, in all climates and under all modes of treatment, is true to the type. The head never gets disproportionally large, the legs never thicken; and the change falls so equally upon all parts of the animal, that one cannot upon any just grounds consider it as a variety.

There is still another circumstance which is worthy of consideration as tending to show the stubbornness with which the nature of the ass adheres to its normal type, and that is the case of hybrids. Analogy points out as a general law of animated nature—and though it has only very recently, and, as one may say, incidentally, been made a matter of scientific research, observation, so far as it has gone, appears to establish the fact—that in the case of hybrids the external form takes more after the male, and the constistitution and disposition, and where there is a difference in that, the internal organisation, takes more after the female. In the hybrids between the ass and horse, however, the stubbornness of the former animal to its normal type appears to give a predominating character to the hybrid.

There are, of course, two hybrids between these species, the *mule* when the male is an ass, and the *hinney* when the male is a horse. The former has not only much more the external characters of the father than of the mother, but it has many of the constitutional qualities—the patience, the temperance, the hardihood, and, as it is called, the stubbornness. The mule is not nearly so showy, so fleet for a short distance, so dashing, or so headlong as the horse, but, give it its pace, and it can do more, endure more, may be said to be at once the most cautious and the most sure-footed of animals; and for these reasons it is chosen to bear loads along paths where hardly any other animal could maintain its footing, even though unloaded. The hinney has some of the external characters of the horse, but not nearly so many as the mule has of the ass; and those which it does have are more localised and broken, and appear in particular parts rather than in the general aspect of the animal. The ears are proportionally shorter than those of the mule, and the head and tail have some resemblance to those of the horse, but the general aspect of the body is not a little asinine. It has none of the qualities of the horse, and even the better ones of the ass appear to be deteriorated by the cross. There is another point:—the beauty and value of mules depend far more upon the superiority of asses than on that of horses; and therefore mules of the best quality can be bred only in countries where asses are less deteriorated than they are in England, though the horses of that country may be of an inferior description.

There is another point still, which though more vague than any of those that have been stated, is yet worth mentioning, if only for the purpose of calling attention to the subject. Mules, though they do not breed with each other, and preserve the broken race, are yet, generally speaking, perfect or fertile animals, and can breed back to the pure blood of either species; but it is said that they return much sooner and more readily to the normal type of the ass than they do to that of the horse. Thus, in every point of view in which it can be taken, the ass appears to be by far the more stubborn to its specific character; and thus, instead of altering in some respects, so as to adapt itself to difference of climate, and remaining unchanged in others, it alters as a whole. It is very important for breeders and cultivators to know that those species which remain stubborn to the normal type, which they have in their native places, are (whether they be animals or plants) much less profitably cultivated over an extensive range of latitude or climate, than those which are plastic to circumstances.

On this account it is not probable that, though the ass is a strong, hardy, healthy, and economical animal, it could be so improved by training, as to make it fit, in this country, for any but the most common purposes, such as relieving the back of the burden, or the limbs of the fatigue of walking, to those who require no faster progressive motion than they could obtain by the use of their own feet. In all other cases, velocity is so important an element, in the saving of time and thereby adding to the efficient length of life, that the comparative cheapness of the ass would be no compensation. The probability, therefore, is, that in England the ass must be left to its present owners, and remain subjected to its present treatment. It is not indeed an animal adapted to very high states of improvement, how valuable soever it may be in those earlier stages of the progress, when the value of time is much less, and a little additional expense is matter of more serious consideration.

The ass is naturally an inhabitant of the wilderness, and therefore a wild and half-cultivated country is the most natural to it. On bleak commons, and among the thistles and other rough and tall plants, which remain asses' food in the greatest intensity of the summer's drought, the ass is at home; but among rich meadows and highly-cultivated fields, it is out of congruity and keeping—a thing of wild nature, while all around it is art and improvement. It seems that the ass itself is not quite in its element in these rich pastures. It gets fat and sleek, but it at the same time gets indolent and less strong and enduring in proportion to its appearance. If the ground is soft, the hoofs of the ass, which are by nature adapted for hard and dry surfaces, get enlarged by an unnatural growth in length, and the feet become unsightly, and the gait of the animal is awkward—circumstances which do not happen when it is upon the dry commons. In England, surfaces which are good for little else appear to be the most congenial pastures for the ass; and in the present state of the country, the ass seems to be the best animal only to those who can afford to keep no other.

This might be inferred from what has been already stated; for if the ass remains so stubbornly true to its natural external type, it must remain equally so to the nature of its pasture and its food, and the nearer that these approach to what it has in a state of nature, the more will it retain the size and vigour which it has there. Plastic animals, which break into varieties adapted to different climates and modes of treatment.

may be improved by culture, so that the domesticated shall, in the qualities which are desired, be much better than the wild; but those which, like the ass, are not so plastic, cannot be improved, or even kept up to their natural state if domesticated. For this reason the domestic ass is in all countries inferior to the wild ass; and though the differences of those of warm and cold climates be very considerable, they are only indications of different degrees of deterioration.

The wild ass is a native of the arid regions of central Asia, where it is still found in considerable troops. These troops shift northward and southward with the seasons, but they are always more southerly and also nearer the desert than those places which are supposed to be the native regions of the horse. This might be inferred from the more arid pastures and hardier plants upon which the ass can subsist, and indeed from the whole character of the animal. The horse is not adapted for living upon those compositæ, with large roots and tall and hard stems, which form the last vegetation before the saline plants begin; but even at that time when we may suppose that these places were unoccupied by human beings, even in nomadic hordes, and as such free to the range of animals, he must, as a matter of course, have kept further down and more in the temperate latitudes, where vegetation is more luxuriant and grasses more abundant and kindly. There seems indeed to have always been an animal of the same genus, intermediate in its pastures between the horse and the ass; and it shows the perfection of the analogy of nature, that it is intermediate also in its appearance and character: this animal is the *dzeggnetai*, or *dshikketei* (*Equus hermionus* of Pallas). Its form and appearance are very much those of a mule; and the probability is that it is the mule of the ancients;—the mule of which mention is made in the Bible, as being found in the desert. It is not a mule, however, but a distinct species, though, like some others of the genus, it appears to be too wild and untractable for domestication. It is still met with in central Asia, of a sort of cream colour, with black mane and tail, and a black line down the back, but without the cross on the shoulders which designates the ass. Its ears are also short; but in other respects the character of its body is intermediate between the two species whose pastures lie on the opposite sides of its range. For reference to the different species of the genus, which includes all the solid-hoofed animals that are known, see the article Equus.

The pastures of the ass, in a state of nature, being thus on the very margin of the sandy desert, where the temperature is always warm, and seldom any rain falls, and the animal being stubborn to its native habits, as well as to its normal type, it is easy to see that in Syria, in Egypt, in Barbary, in the isles of the Mediterranean, in Spain, in all the south of Europe, and even in those parts of the middle latitudes where there are long tracts of drought in the summer, the ass must be much superior to what it is in England. In all cases, however, the domesticated ones (they cannot be called a domestic *variety*) are inferior to those which are wild. From a saying, which must have been a current one and in accordance with the truth, as it is inserted in the Proverbs of Solomon, the ass must have been a spirited animal in Syria. "A *whip* for the horse, and a *bridle* for the ass," are the words of the proverb in so far as it refers to these animals; and the fair inference is, that the horse being used for warlike purposes, required the application of the whip to urge him on; whereas the ass, used for the ordinary purposes of domestic life, required only the bridle to guide him in the direction required. In the south, though not a very fleet animal, it is still one upon which long journeys can be performed, as it is longer in wearing out, and does not so often require to stop for refreshment as the horse. It is hardy and tenacious of life, even in those countries where it is upon the whole the most deteriorated; for even in those places where they are most abundant in the living state, it is rare to see a dead ass.

The generic characters will be mentioned in the article Equus. The specific ones are few in number, and as all are familiar with the appearance of the animal, they do not require to be mentioned with any minuteness of detail. The long ears, the cross on the shoulders, the tuft at the end of the tail, which is naked or has only short hair for the greater part of its length, and the absence of warts or callous tubercles on the hind legs, are the specific characters which distinguish it from the horse. In a state of nature, the hoof is also narrower in proportion, and better adapted for walking upon hard surfaces: in the teeth and the whole internal structure, there is much uniformity in all the genus.

ASSAFŒTIDA of the druggist, and *Ferula assafœtida* of botanists, a native of Persia. Linnæan class and order *Pentandria Digynia;* natural order *Umbelliferæ.* Generic character: involucrum varied; flowers polygamous, fruit compressed, smooth, margin thickened; costæ very obtuse below. This plant has a large fusiform root, and it is cultivated for the juice which it yields, and manufactured for exportation.

ASSIMILATION, *in Physiology,* is that property, or principle, or whatever else it may be called, by means of which organised beings, whether vegetable or animal, take to themselves, and convert to their own substance, structure, or organisation, those foreign substances which constitute their pabulum or food. The subject is one of great importance, more so perhaps than any other of a merely material nature, which can draw the attention or exercise the industry and sagacity of mankind. Upon it depends the success of every method and instance of culture, and the condition and value of all that can be cultivated. Upon it also depend our bodily strength and health, and all that can render life worthy of being enjoyed.

But the obscurity and difficulty of the subject are as great as its importance; and thus it is one which probably never can be brought within the scope of demonstrative philosophy. The foundations of it lie in the very elemental workings of nature, where the produce of the work is yet too small for our observation; and even in the full-grown subject, where we can trace the process a greater or less way, according to its nature and our opportunities, there is always a point at which we are left in the dark, and our being so left reduces that which we have previously traced to comparatively little value.

The reason of this is very plain, and it is such a reason as to render the success of any attempt at the full elucidation of the subject doubtful, if not hopeless. That reason is this: the important part of the process, that in fact upon which the whole depends, does not come within the province of the philosophy of matter (the only demonstrative philosophy that we have) in any of its forms. It cannot be accounted for mechanically; as little can it be accounted for chemically; nor do we succeed better when we attempt to explain it by a combination of the two. There are mechanical changes no doubt, and there are also chemical changes, but there are others which are neither mechanical nor chemical, and in these we neither know the cause nor the process. It is true that they are invariable concomitants of life, and that we never can find them but in the living subject. Therefore we may say that they are actions of the *principle of life*, or the *living principle.* But either of these expressions is precisely of that nature of which we, on a former occasion, mentioned that the word "instinct" is an example; they enable us to fill up by sound in our words those gaps which the failure of our knowledge leaves in the sense of what we say, and they do nothing more. These necessary ignorances do not, however, lessen the value of that which we really know, only it is important for us to know where they lie, because that prevents us from wasting our time and labour where there is no knowledge to be found; and had we always been aware of and avoided them, all of us might, with the same exertion, have been very much wiser than we are.

Taking these precautions with us, to prevent us from wandering into idle speculations, the subject of assimilation becomes one of the most interesting that can occupy our thoughts. It is indispensable to the growth of all organic beings, whether animal or vegetable; and it is equally essential to their being in a healthy state. It forms, indeed, one of the most unequivocal criteria of organic life, for there is nothing analogous in the inorganic or the dead world. The growth of stones and the formation of crystals, have sometimes been adduced as instances analogous to vegetable, and even to animal growth; but there is no assimilation in these; the substance though changed in form is not changed in nature, either by accretion into a stone, or by arrangement into a crystal.

As we are in a great measure ignorant of the food of vegetables and their mode of feeding, any thing that can be said about assimilation in them, will be much better left to Vegetable Physiology, or to some of the articles subordinate to that. This is further desirable, because perennial vegetables, which continue to increase by growth for more than one season, grow by a sort of accretion, or the mere addition of new parts, while the portion once grown never increases or undergoes any change except what may be impressed upon it by causes external to itself. No doubt, in the animal kingdom, pearl shells grow something in the same manner, as may be seen in the successive additions to the shell of an oyster or a periwinkle, but crusts grow more upon the animal principles; and probably the porcelain shells grow something in the same manner, though that is a subject upon which we have very little information.

We shall render the few remarks which we have to make more clear, and therefore give them a chance of being more generally acceptable and useful, if we narrow the subject still further, and consider assimilation as it takes place in vertebrated animals only.

It is probable, nay certain, that the process of assimilation is coeval with the very first development of the animal germ, nay, with the very commencement of its existence, as an organic being. This part of the subject is exceedingly obscure, and as is the case with all obscure subjects which are at the same time interesting, there are many theories and opinions respecting it. The most rational of these opinions, and the one which accords best with the analogy of nature, and carries us through the other parts with the greatest security from error and absurdity, is that which, we believe, was first advanced by the great Harvey. This is what is usually termed the theory of *Epigenesis*, or that which dates the very first rudimental existence of the animals from "the act of organisation," and denies the existence of all pre-existent germs, except as mere materials to be rendered available by that act. In no other way is it possible to account for the production of mules, or even for that more universal sort of hybridism, by which the progeny generally partakes in some degree of the qualities of both parents. But though assimilation goes on in those early stages, and goes on in a more extraordinary manner than at any future period, inasmuch as it *makes* the whole organic structure of the animal, the process there is so exceedingly nice, and so little is known about it, that it cannot possibly be rendered useful or even intelligible in popular description. We shall, therefore, still further narrow our observations, by confining them to the process of assimilation in the animal, after it is capable of subsisting by itself upon the ordinary food of its species.

We shall suppose that the whole of the matter which is assimilated is taken by the mouth as food; for though there are other circumstances, such as the state of the atmosphere, and the kind and degree of action to which the body of the animal is subjected, which affect assimilation, yet they form no specific part of it, and can be regarded as affecting it only as they affect the other functions, that is, as external circumstances.

The first process which the food undergoes may be said to be purely mechanical, and might be done by other means. This process is mastication, or chewing, on the part of many of the mammalia; trituration or grinding in gizzard birds; and maceration, or softening, and solution in a fluid in some other animals; but in whatever way it is performed, it is a merely preparatory process, not at all connected with assimilation; and when there is a liquid in the case, it is to be considered only as a mechanical solvent, that is, as softening or dissolving the food with which it mixes, much in the same way that water softens and dissolves glue.

This preparatory operation, and indeed the whole process of assimilation, depends a good deal upon the nature of the food. When that is entirely animal, the whole of the processes, and also the apparatus by which they are performed, are much more simple than when it is wholly vegetable; and even in the case of vegetable food, that which is wholly pulpy and farinaceous, requires a simpler apparatus and processes than that which is mixed with fibrous matter. The adaptations of all the parts of this apparatus (which, taken together, are called the *digestive* system, or *nourishing* system, of the animal) to the various kinds of food upon which animals live, exhibit some of the most beautiful instances of means and end that are to be met with in the whole economy of nature; and they are also of great value in that natural classification of animals, by means of which the history of one is made to throw light upon the history of a number, and one part of the history of one is made to throw light upon the other parts. The general law is, that the nearer the food in the state in which it is received by the mouth approaches to the nature of the animal receiving it, the apparatus of assimilation is the more simple, and the operation the more easily performed. But still, so much is each animal an independent being in its substance, that no kind of food goes into the substance or constitution of an animal without undergoing a total change in the process of assimilation. Even if the animal preys upon its own species, as is by no means uncommon among some of the fishes, in which case the food and the feeder may be supposed to make the nearest approximation to each other, the food undergoes as complete a change as if it were the substance most foreign and opposite to the nature of the animal that can be imagined. It is worthy of being borne in mind, too, that in the same animal, or the same species, the product of assimilation is nearly the same, however different the food may be ; or that different kinds of food produce differences in the *quantity* of assimilated product rather than in the *quality*. Consequently, when we say that the food of an animal is of bad quality, we simply mean that it is deficient in nutriment; or if we have any further meaning, it must be, that the food contains some deleterious ingredient which in so far acts as a poison.

The second part of the process is *digestion*, which usually takes place in the true stomach of the animal, although some animals appear to have a digestive power in the gullet, or passage leading from the mouth to the stomach. It is here that the mystery begins ; for though the stomach may be said to exert both mechanical and chemical powers in the process of digestion, yet there are other results produced in it which cannot well be attributed to either. While the process of digestion is going on, the stomach is in continual motion, contracting in one place and expanding in another, as if it were wriggling as a worm does ; and hence this is called its *vermicular*, or worm-like motion.

The most powerful, as well as the most singular agent in the stomach, appears, however, to be the *gastric juice*, a peculiar fluid which is secreted or given out by the inner coat of that organ, and which not only exerts a very powerful action in chemically dissolving the food, but also produces some changes in it which cannot be explained upon any known principles of chemistry. The energy of this fluid has been proved by direct experiment : it has been obtained from the stomach of the living subject (which is neither difficult, nor attended with the slightest danger) ; and by being kept at nearly the natural temperature, it has, to a considerable extent, effected the process of digestion in a separate vessel, in which there could be no vermicular motion to assist its action.

This gastric juice is somewhat singular in its operation. It will dissolve cartilage, bone, and even, in some cases, iron ; but it will not dissolve the skin of a berry, the least bit of cork, or the smallest fibre of cotton wool. It is one of those animal fluids which are so perplexing to the chemist in his investigations, and might alone demonstrate the fact, that life is something which neither mechanics nor chemistry can reach, and in the production of which they can consequently have no concern. Not only while in the stomach of the living subject, but after it is removed, this fluid produces what appear to be very powerful chemical effects ; but when we subject it to chemical analysis, we are unable to detect in it any ingredient to which such effects could, chemically speaking, be attributed : in other words, we discover nothing.

There are two properties of the gastric juice, which seem worthy of separate notice. These are, the prevention of putrefaction, and the coagulation of albumen. The first of these is in opposition to one of the theories of digestion, by which it was maintained that that process is a species of putrefaction. But so far is that theory from being true, that it is well known that if putrid matter of any kind is admitted into the stomach or any part of the digestive organs, in many animals, it is attended with serious and even fatal effects. The gastric juice while it performs that sort of decomposition which is necessary for preparing the food for assimilation, prevents the putrefaction to which the food might otherwise have a tendency, and it seems also to prevent chemical solution by the action of one part of the food upon another. Chemical actions, such as the production of an acid or a gas, do indeed sometimes take place in the stomach ; but these are always disagreeable, and consequently the results of something wrong in the functions of that organ. The coagulative power is, perhaps, more singular ; but coagulation is a subject upon which our knowledge is very obscure and vague. The fact is well known, however, even to those who are equally ignorant of chemistry and physiology. There is not a nurse in the country, but knows that the stomach of an infant is disordered, when it returns the milk of its nurse uncurdled ; and dairymaids have from time immemorial employed the *rennet*, the red or gastric juice from the stomach of animals, for curdling milk in the manufacture of cheese.

The action of the gastric juice, assisted by the vermicular motion of the stomach, converts the food into an uniform pulpy mass, changed in appearance and odour, and which is known by the name of *chyme*. This name means that which is softened and mixed together ; and, therefore, it is expressive of the substance, though not of the process by which it is formed. The solution is, indeed, a peculiar one ; the food is reduced to a pulpy mass, and though there may be a difference in the food, that mass is in the same species of animal in the same state of health always nearly the same. The solution which it has undergone is a peculiar one ; for though it is softened and moistened, it is not dissolved, neither is it soluble in water.

When the food has been properly reduced to chyme, the action of the stomach forces it through the pyloric opening into the duodenum, where it mixes with new secretions from the animal, and undergoes another change. Not far from the commencement of the duodenum, at the pyloric orifice of the stomach, the gall and pancreatic ducts pour their contents into it ; the first the bile, and the second the pancreatic juice. What specific part these perform in the general process of assimilation, is not known ; but it is presumed that their action, especially that of the bile, is very important, both because of the size of the liver by which it is produced, and because of the great derangement which takes place in the whole process of assimilation when that organ is diseased.

At or near that part of the duodenum into which the biliary and pancreatic secretions are discharged, the chyme begins to be separated into two parts, the relative proportions of which vary with the quality of the food. The first is the *chyle* (which means juice or extract), a milky fluid, which is the assimilated matter; and the refuse, or that part which is either indigestible or unfit for being converted into chyle. But the latter still contains a portion of chyle, or matter fit for being changed into chyle, and that is gradually separated in the progress through the remaining parts of the intestinal canal.

It appears that vegetable food is acted upon with more difficulty by the gastric juice, in the first part of the process, than animal food; and it further appears that, after it has been converted into chyme in the stomach, the chyle is with greater difficulty separated from the refuse. For the preparation of vegetable food, by mastication in the mouth, by maceration in preparatory stomachs, or by both, is a much more complicated operation. The intestinal canals of vegetable feeders are also much larger, and the chyme is in consequence subjected to a greater continuance of the action of these viscera. The contents of the intestines are urged onward, from the entrance to the termination, by a sort of vermicular action, which is called the *peristaltic* motion, and which bears some resemblance to the motion of the stomach, only it is more progressive.

The separation of the chyle, which may be considered as the second stage in the process of assimilation, and which continues, though gradually diminishing, through a considerable portion of the intestinal canal, is very obscure in its nature. There are three agencies which may be supposed to be concerned in the production of it:—first, the action of the different parts of the chyme upon each other, the efficacy of which is rendered probable by the fact that certain substances are more nutritious when taken into the stomach together than either of them is when taken singly; secondly, the influence of the bile and pancreatic juice; and thirdly, the action of a peculiar secretion of the inner coat of the intestine itself. Whether one, or another, or all of these produce the effect, or if all, how much is to be attributed to one, and how much to another, is not known. Thus, in this part of the process of assimilation also, we are left in doubt both as to the agent and the specific effect.

From the intestinal canal, and especially from the duodenum, in which it is most copiously produced, the chyle is taken up by the lacteal vessels. These are small tubes which open on the inner coat of the intestine, not by mouths equal even to their small diameters, but each by a number of very minute pores or villi, which radiate from a centre, and whose openings are so small that they admit only the most minute substances. These lacteals with their villous openings continue along the greater part of the intestinal canal, but they become less numerous, as the food advances, and furnishes a smaller quantity of chyle. From the intestine they proceed along the mesentery, uniting into thicker trunks, and also anastomosing with each other, so as, in some instances, to form a sort of network. They also contain numerous valves, and as the seats of these do not expand along with the intermediate parts, the distended lymphatics appear to consist of a succession of little barrels or beads.

All the lacteals discharge their contents into the lower extremity of the thoracic duct, which ascends in the back part of the thorax, and pours its contents into the left subclavian vein near its junction with the heart. Thus the assimilated product of the food is mixed with the mass of the blood. In their course from the intestine to the thoracic duct, the lacteals pass through one or more glands; but whether their contents undergo any change, and if any, what that change is, are obscure points. The chyle differs from blood in many respects, one of the most obvious of which is a considerable admixture of sugar and water.

The chyle does not go to the blood alone, but mingled with the contents of the lymphatic vessels, which appear to fetch their colourless contents from all parts of the body, and united enter the thoracic duct; but as the fluid which they contain comes from the living parts of the animal, it must be considered as a previously assimilated substance; but whether it again enters into the circulation, and if so, what office it performs, are points upon which we have no information, and they form no part of the process of assimilating.

The blood with which the chyle, or new matter, is mixed, does not immediately go over the body in the course of the systematic circulation. It passes immediately into the right auricle of the heart, thence it passes into the right ventricle, where the valves between the two prevent its return. The contraction of the ventricle sends it along the pulmonary artery to the lungs; and after undergoing the action of the air inspired in breathing there, it returns by the pulmonary vein to the left auricle, thence to the left ventricle, and by the action of that and the systematic arteries, it is sent all over the body. The quantity of chyle which mixes with the blood at each pulsation of the heart must be very small, as there is no trace of its colour in the blood which is sent to the lungs, which has the dark colour of venous blood. But the minute division of the blood in its passage through the lungs must tend to the intimate union of the chyle with it, and it may be possible also that the action of the lungs is necessary to perfect the assimilation, and finally convert the chyle into blood, but the agent and the process in this final step of the process are just as obscure as in the two preceding ones.

We have now followed the progress of the food from its first entrance by the mouth of the animal to its union with the mass of the blood, which is understood to be the fluid which supports the growth and repairs the waste of all the parts of the body. In this we have done nothing more than give a simple outline of the process of digestion; but this is, in truth, all that can be given. We have seen that, besides the merely mechanical preparation of the food, there are three distinct operations:—the formation of chyme in the stomach, the separation of chyle in the intestines, and the turning of that chyle into blood after it has passed into the subclavian vein. There may be others, by the glands through which the lacteals pass, and the union of the lymph with the chyle in the thoracic duct; but instead of knowing how these take place, we have no evidence of the fact that they take place at all; and therefore it would be unwise to darken further with them a subject which in its own nature is abundantly obscure. Our inquiry reduces the assimilation to three distinct processes or acts, and we can tell plainly enough *what* takes place at each of them; but in none of them can we tell *how*, or *by what agency*. We can indeed bring all three home to the living animal, by showing that they are neither chemical nor mechanical, from which it follows that they could not be performed by the properties of mere matter, or originate in any new case, except in the ordinary way in which the animal is produced. This is but a small matter in respect of positive knowledge, but it is an important one in the prevention of error.

But when we have followed the progress of assimilation through all the steps that have been traced, from the mouth to the discharge of the arterialised blood from the left ventricle into the aorta, for the purpose of being sent all over the body, we have traced the process only to what may be considered as the beginning of its most curious work. Out of that general circulating fluid there have still to be elaborated all the parts of which an animal consists, and all the products of those parts, whether they be turned to use in the system, or discharged out of it. Of the same fluid are formed bones, ligaments, tendons, muscles, membranes, skin, hair, feathers, nails, horns, teeth, and all the parts of which an animal with such a circulation as has been described can consist. The blood has even to maintain the vessels, and furnish the fluids, by means of which it obtains its supply. Those local assimilations constitute the wonder of the matter, in comparison with which all the external actions, habits, and economy of animals, curious as some of them are, sink into comparative insignificance.

When we contemplate the external actions of animals, we are apt to speak about their reason, and wisdom, and intelligence; but where is the intelligence here? Even in ourselves, all these operations take place, not only without what we vainly, but by no means correctly, call our *will*, but without our ing in the least aware of their occurrence. When they are suspended, or in any way go wrong, we are indeed admonished of the fact by the uneasy sensations of pain and disease. But when the derangement is in those internal and constitutional functions, how little can we tell of what is the matter with us beyond the mere uneasy sensation? And how often are those who have made the structure and functions of the body the subject of most careful and scientific study nearly as much in the dark as we? When we find that all these operations are constantly going on, in manners as varied as the species of animated beings, without design, purpose, or knowledge of the creatures, but merely in virtue of that law of the species which has been given to it by its Creator, descending without change through countless generations, what small reason have we to perplex ourselves about the causes of those far more simple external operations which individuals or races perform? If, in the mightier matter, we must admit the operation of Divine wisdom and power, through the fulfilment of the law which Divine goodness has seen meet to institute, with what consistency of philosophy, with what pretensions to even the humblest shade of reason can we deny, doubt, or question it in the less? Such conduct cannot be called impious, because impiety involves the abuse of at least a certain portion of knowledge; but it is the most gross and utter ignorance; and as it is but too often ignorance which is vain in its own conceit, it is in these cases as hopeless as it is humiliating.

And yet, wonderful as all these organisations are, working unseen and unknown to the owners, and working with the utmost perfection, the special marvel of the whole, that which should humble man in his own eyes, and send him to adore, where adoration is the path of sound wisdom and genuine happiness, remains behind. Whence come all those varied organisations, whose functions are so very curious, and performed in so admirable a manner? They, too, are of the same law—the same simple but sure mandate, which once given forth at the moment of creation, shall remain and operate immutably till time be no more. "Γενεσθε—και 'Εγενετο."—Let the world arise!—And the world arose in all its beauty, and all its inhabitants, in all their forms, functions, and habits, perfect and self-sustained, until He shall command it back into its primæval nothing.

And this, too, is effected in the most silent, and apparently the most simple manner. An egg, for instance, which is perhaps the best form in which to contemplate the beginning of life, is found, upon analysis, to consist of very simple materials; and the egg is walled in by its shell, so that, save the air, through its pores, and the all-pervading influence of heat, it can receive nothing from without—no material substance—nothing that has weight in the scale can be added to its contents; and in the progress of its vivification it no doubt gives out matter, a portion of carbon in the state of carbonic acid gas, for it becomes specifically lighter.

The egg thus contains within its shell both the workman and the materials; and though, in the usual course of nature, it is hatched by the heat of the parent bird, yet there is no specific virtue in that heat which renders it indispensable for the purpose; any heat will do, so that it is in the proper degree and maintained with the proper uniformity. If we take in the whole range of oviparous animals, there are far more eggs cast upon the common bounty of nature than there are tended by the animals which produce them; and those which are so cast fail not a jot more than the others. Countless multitudes of reptiles, fishes, insects, and molluscous animals, commit their eggs to the earth or the waters, or fix them upon, or insert them in the bodies of plants or animals; and these succeed as well as the eggs which are hatched under the most careful bird, or the young of the mammalia, which are brought to maturity in an internal matrix. All these facts, and many analogous ones, which will readily suggest themselves to the reader, tend to show that, from the very instant that the act of organisation passes upon it, the life which is in the egg is that of a distinct and separate being, endowed with all the powers of assimilation, by means of which it can evolve itself to maturity, and maintain its existence for the average of that period of life which is the portion of its species. Once begun, the animal organisation does not require, and indeed cannot receive, the aid of any helping hand from without; but, placed in the proper circumstances, and when not interfered with, the law of nature arranges and adapts these; it works on for its appointed period, and in its appointed way, free and independent.

The vital part is, in the recent egg, a very simple matter—a little of a jelly-looking substance, barely distinguishable; yet, by the action of heat, this simple thing elaborates out of the matter contained in its storehouse, those membranes, with their blood-vessels and blood, which are necessary for its own development. It forms this apparatus gradually as is required, and germ and apparatus then work together, in all the curious operations which take place ere the chick comes out of the egg. Out of the apparently simple contents of that, there are elicited viscera, and bones, and muscles, and nerves, and membranous tissues, and skin, and feathers, and scales, and horny beak and claws;—all the organs which we afterwards admire so much in that beautiful creature, which sings from the spray, wheels swiftly through the air, or rides gracefully upon the water.

And all is effected by the power of assimilation, and that too apparently without a point from which to commence. Assimilation is thus totally different from accretion or crystallisation. In these, new portions of the same matter are merely added, without any change; but assimilation prepares a new material, and either places it where there was no such material before, or replaces with it other matter which has ceased to be fit for the economy of the animal. See GROWTH.

ASTACIDÆ (Leach). A family of annulose animals belonging to the class *Crustacea*, order *Decapoda*, and section *Macrura*, and containing the lobster tribes. In this family the abdominal portion of the body is much longer than the thorax. The eggs are retained in a large pouch beneath the breast, the first pair of legs are generally very large, and terminated by hooks, claws, or a machine for swimming, and the antennæ, of which there are two pairs, are inserted in the same horizontal line, the interior ones with moderate or long footstalks, and terminated by two filaments, and the outer ones naked or furnished with a scale, which never entirely conceals the base.

These characters will at once distinguish the lobsters from the hermit crabs (*Paguridæ*), and prawns and shrimps (*Palæmonidæ*).

This family includes several distinct groups of species, and we have also introduced into it the spiny lobsters or cray fishes (*Palinurus*), which Dr. Leach considered as forming a distinct family (*Palinuridæ*), chiefly from the small size of the fore-legs. These animals, however, which are constantly sold by the London fishmongers, are too closely allied to the lobsters, as may be seen even upon a casual inspection, to warrant their establishment as a distinct family, especially since we see, in the adjoining families, amongst the shrimps, for instance, that the size of the anterior locomotive organs becomes a character scarcely of generic rank.

The extremity of the abdomen is constantly furnished with a fan-like apparatus for swimming, composed of five plates, and the tegumentary envelope of the body is always of a hard and calcareous nature.

The 1st sub-family, *Scyllarides*, is distinguished by the remarkable construction of the lateral antennæ, which are much shorter than the thorax (which is broad and flat), and instead of being slender, are dilated into very broad and flattened plates, having the appearance of a cock's comb; the fore-legs are monodactyle and small, resembling the others, the extremity of the caudal apparatus for swimming is membranous. These crustacea appear in warm climates, some of the species being found in the Indian and other tropical seas, whilst others are taken in the Mediterranean; the latter are known by the name of Cigales de mer, which they probably owe to the noise which they make in swimming: they burrow in clayey soils close to the shore. To this subfamily belong the genera *Scyllarus* (Fabricius), of which the *Cancer arctus* of Linnæus may be considered the type; *Thenus* (Leach), *Scyllarus orientalis* (Fabricius), and *Ibacus* (Leach—*Ibacus Peronii*), from New Holland.

The second sub-family, *Palinurides*, resembles the former in the simple fore-legs and the membranaceous termination of the swimming plates, but the thorax is convex, and not widened in front, and the lateral antennæ are very large, spinose, and much longer than the whole body. One genus only, *Palinurus*, (Fabricius), belongs to this division; it includes some of the largest of the macrurous (long-tailed) crustacea, and the species are in general of elegant colours. They are termed langoustes by the French, a name probably vulgarised from locusta, under which term they were known to the Romans; by the Greeks they were denominated carabos, and Aristotle has given various important observations upon their natural history. It is singular that the common species, in the west of Europe, although noticed by all the old naturalists, should have been overlooked by Linnæus. This is the species of shell-fish sold in our fish shops as the spiny lobster, and is highly prized as an article of food. It is the *Palinurus quadricornis* of Fabricius, the *Cancer elephas* of Fabricius, the *Palinurus locusta* of Olivier, and the *Palinurus vulgaris* of Latreille and Leach. During the winter it seeks the deeper parts of the ocean, but at the return of spring it approaches the shores, preferring rocky situations where it deposits its spawn, which is of a beautiful red colour.

The third sub-family, *Thalassinides*, consists of several interesting genera, of which the majority are natives of our own coasts; they are of small size, and have much of the appearance of small lobsters, the abdomen being long, and terminated by a swimming apparatus of an entirely crustaceous substance; the first pair of legs is terminated by large claws, and the third pair is never furnished with a two-fingered claw; the exterior lamellæ of the tail are composed of one part only. This sub-family comprises the Indian genus *Thalassina* (Latreille), and the British genera, *Gebia* (Leach), *Callianassa*, (Leach), and *Axius* (Leach). The latter are found on the southern coasts of Great Britain, where they burrow in the sand to a very considerable depth.

The fourth sub-family, *Astacides*, have the abdomen long, and terminated by scaly lamellæ for swimming, of which the exterior ones are bipartite. The fore-legs are very large, each with a powerful claw, and the four following legs are terminated by two-fingered claws. This sub-family comprises the lobsters and cray-fish; of the former, the *Cancer gammarus* of Linnæus, which inhabits the rocky shores of our coast, is the type of the genus *Astacus* of Fabricius, and the latter, which Dr. Leach has formed into a distinct genus, *Potamobius*, is found in all our fresh water streams. Their food consists of decayed animal matter, and it is with this, as a bait, that the majority of the vast numbers which are annually consumed are caught.

The LOBSTER, whose economy we shall detail under that word, is distinguished generally from the cray-fish by the middle lamella of the tail being composed of a single piece, and by the sides of the abdominal segments being obtuse.

The *Cancer Norvegicus* of Linnæus, found on the coast of Norway, is the type of the genus *Nephrops* of Leach.

ASTARTE (Sowerby). CRASSINA (Lamarck). VENUS (Montague). This shell resembles a small crassatella in appearance, being thick and solid, and the valves perfectly closing together in every part; but the position of the ligament distinguishes it: nor should it be confounded with the genus *Venus*, since it has not more than two teeth on each valve; and even appears to have but a very large one on the left valve, the other projecting but slightly. The shell is orbicular, transverse, equivalve, inequilateral, and closed; ligament external, and placed on the longest side. Several species of this mollusk having been described by authors previous to Lamarck, under the name of Astarte, Sowerby very properly objects to that of Crassina; De Blainville has, however, included it in that of Venus, and it stands in the second section of the eighth family, *Conchacea*; third order, *Lamellibranchiata*; third class, *Acephalophora* of his system.

ASTATA (Latreille), Dimorpha (Jurine). An elegant genus of hymenopterous insects, belonging to the section *Fossores*, or burrowing sand wasps, and family *Larridæ*. The eyes are very large, uniting behind in the males, whence the name given to these insects by Jurine; the wings have one marginal appendiculated cell, and three submarginal ones. These insects are extremely active, to which the name astata has allusion, and they usually provision their nests with the pupæ of some of the field bugs (*Pentatomæ*), the females in general taking their stand upon small lumps of dry cow dung, in hot situations. Mr. Curtis has figured a species, under the name of *Astata victor*, but from an examination of authentic continental specimens of the *Ast. abdominalis*, it appears that his insect is evidently that species.

ASTELMA (R. Brown). A family of beautiful undershrubs, natives of the Cape of Good Hope. Linnæan class and order, *Syngenesia superflua*; natural order, *Compositæ*. Generic character: anthodium imbricated, the inner scales channelled, and a little coloured; receptacle furrowed, downy; florets of the ray female, imperfectly attenuated; pappus hairy, rough, pencilled at the top, somewhat feathery. There are ten species of this fine family, all of which have formerly been known by other names, as gnaphalium, elechrysum, &c. The genus is now arranged in two sections, namely, *Conniventia*, involucres connivent; and *Radiata*, involucres radiate.

ASTEPHANUS (R. Brown). A genus of two species of climbing plants from the Cape of Good Hope. Linnæan class and order, *Pentandria Digynia*; natural order, *Asclepiadeæ*. Generic character: corolla somewhat bell-shaped, the throat of the tube naked; gynostegium like a bee.

ASTER (Linnæus) Starwort.—An extensive family of perennial plants, sixteen of which are shrubby, and the rest herbaceous. Linnæan class and order, *Syngenesia superflua*; natural order, *Compositæ*. Generic character: anthodium imbricated; receptacle naked; radius of two colours. Of this genus there are one hundred and fifty-four described. They are found in many parts of the world, but chiefly in North America. Almost all are ornamental, and decorate our gardens in the autumnal months. Some are splendid: one of them, *A. amellus*, was celebrated by the Mantuan bard. The family is divided into eight sections, founded on the character of the stem, number of flowers, and form of the leaves.

ASTERIAS (Linnæus). A genus of shells belonging to the division *Radiata* (Cuvier), and to the class *Echinodermata*; section, *Stellerides*.

This animal has a suborbicular depressed body; its circumference divided into angles, lobes, or rays, each of which has a longitudinal furrow in its centre, fringed on each side with moveable spines, and orifices for the tubular or retractile feet; mouth central, and placed beneath, at the union of the grooves, as in the

Asterias rubens (Red Star-fish), with five lanceolate, papillous, and spinous rays; papillæ of the back scattered, and set nearly in rows.

These animals inhabit the sea, and are usually found on the sand, or among the rocks on the sea-shore, below high-water-mark. Their covering is a fleshy, sometimes coriaceous crust, defending them from the attacks of smaller animals; and they possess five or more rays proceeding from a centre, in which their mouth is situated. Each ray is furnished with a prodigious number of tentaculæ, in some amounting to fifteen hundred; and when the animal is thrown on its back, these may be observed projected and withdrawn, like the tentaculæ of snails; by the undulatory motion of these rays the star-fish is enabled to swim, but its progression is extremely slow. Their powers of reproduction are considerable; for if by any violence a ray be broken off, a new one will shortly be produced. The mouth is armed with bony teeth, which are used in seizing and breaking the shells of fishes on which the animal feeds; from this a canal extends to each of the rays, running through their whole length, and becoming narrower as it approaches the extremity.

Persons wishing to preserve specimens of these animals should kill them in brandy or other spirits, keeping the rays expanded in their proper positions, extracting afterwards the stomach and its contents through the mouth by means of forceps.

One species, the *Asterias caput Medusa* of Linnæus (Medusa's head star-fish), mentioned by Shaw in his Naturalist's Miscellany, is occasionally found in most seas, but particularly at the Cape of Good Hope. It has five equidistant thickly-jointed processes proceeding from its centre, each of which is divided into two other small ones, and each of these into two other still smaller; and this mode of regular subdivision is continued to a vast extent, and in the most beautiful order of minute gradation, till at length the number of ramifications amounts to several thousands. One specimen, measuring three feet diameter, had five hundred and twelve extremities to each ray, so that the whole number amounted to two thousand five hundred and sixty. By this most curious structure the animal becomes as it were a living net, and is capable of catching such prey as is destined by nature for its support, the object being secured from all possibility of escape by the sudden contraction of these innumerable ramifications.

Marvellous stories are told of the size of these animals; one traveller having asserted that they are capable of entangling and drawing down a ship's boat. This circumstance needs the confirmation of other persons, though doubtless they sometimes attain a very great size; and it would appear that the minute ramifications of the extremities of the radii multiply in proportion to their distance from the centre of the animal. The great difficulty of expanding these animals in a dried state without injuring their delicate parts prevents their being frequently measured. The state in which they are preserved in cabinets presents the appearance of a turban, the rolled edge of which is composed of countless tentaculæ, intertwined in inextricable confusion, yet with considerable symmetry of arrangement.

ASTERODERMUS—starry-skin. A genus of spinous-finned fishes, belonging to the natural family of the *Coryphenes*, which are surface fishes in the warmer seas, but strictly pelagic, driving about with great rapidity, and most dexterous in the capture of smaller fishes. The *coryphene*, properly so called, is understood to have been the dolphin of the ancients; and it is still called the dolphin by the Dutch, though the true dolphin of modern times is not a fish, but a warm-blooded animal which suckles its young.

The asterodermus has the long dorsal fin of the coryphene, extending nearly from the occiput to the tail; the head also is ridged, but the gape is not proportionally so deep; the ventral fins are shorter, and placed under the throat, and there are only four rays in the gill-flaps, while those of the coryphene have seven. The scales are scattered thinly over the body, and are of a rayed form, like little stars, whence the name.

There is only one known species, an inhabitant of the Mediterranean. It grows to a considerable size, and is of a silvery colour, with black spots, and red fins, the dorsal fin being very high. It is the *Asterodermus guttatus* ("dropped" in allusion to the black spots) of Bonnelli, and the *Diana semilunata* of Risso.

ASTRANTHUS (Loudon). A single shrubby plant, found in Cochin China. Linnæan class and order, *Heptandria Tetragynia;* natural order, *Homalineæ.* Generic character: calyx with a short tube, limb from ten to fourteen cleft, segments alternately less; stamens, ten or more; anthers round; style like a hair; caryopsis included in the tube of the calyx.

ASTRAPÆUS (Gravenhorst). An interesting genus of coleopterous insects, belonging to the section *Brachelytra* (*Staphylinus*, Linnæus), and subfamily *Staphylinides*, and distinguished from every other genus in that large group by the four palpi, which are terminated by a hatchet-shaped joint; the tarsi are very much dilated. The species reside beneath the bark of trees. The only British species, *Astrapœus rufipennis* of Leach, is extremely rare in England, one specimen only having occurred at Coombe Wood, in Surrey, and one in Devonshire.

ASTRAPÆA (Lindley). A genus of three species of lofty trees, introduced from Madagascar. Linnæan class and order, *Monodelphia Dodecandria;* natural order, *Byttnericeæ.* Generic character: flowers umbelled, involucred; involucres imbricated, many leaved, the interior leaflet rather less; calyx bracteated, lance-like, sustained, membranaceous, five-sepaled, erect; corolla five-petaled, convolute; stamens united to the tube; anthers oblong, erect, bifid at the base, five of them sterile; style like a thread; stigmas five; capsule five-celled, each with two seeds. This family of plants are said to be the most beautiful in the world.

ASTREA (Lamarck). A genus belonging to the class *Polypii;* fixed, stony, and incrusting submarine bodies, forming hemispherical or globular masses, which are rarely lobed; the upper surface crowded with orbicular or subangular lamellæ, or sessile stars.

1st subdivision, with the stars separated from the base, *Astrea radiata*, rayed astrea. 2nd. With contiguous stars, *Astrea denticulata*, toothed astrea. The first inhabit the American seas, West Indies, &c.; the second inhabits the Indian seas. See MADREPORE.

ASTROCARYUM (Meyer). A genus of five species of Brazilian palms. Linnæan class and order, *Monœcia Polyandria;* natural order, *Palmæ.* Generic character: flowers monœcious, in a simple spatha; male flowers on a rachis; calyx three-cleft; corolla bell-shaped, three parted; female flowers within male spikes, solitary; calyx urn-shaped, edge three-toothed; corolla bell-shaped, edge three-toothed, double within; style conical; stigma simple; drupe fibrous, one-seeded; three pores at the top like a star; albumen hollow, equally thick; embryo within the pores.

Dr. Von Martius, who has described the palms of Brazil, mentions this among others, but nothing very particular that is not referable to others of the tribe.

ASTROLOMA (R. Brown). A genus of two species of evergreen shrubs from New Holland. Linnæan class and order, *Pentandria Monogynia;* natural order, *Epacrideæ.* Generic character: calyx five-cleft, bracteate; corolla, tube swollen, at the base of the tube a tuft of five hairs; limb short, spreading, bearded; stamens included; disk surrounds the germen, concave, entire; drupe pulpy, shell bony, five-seeded.

ATALANTIA (Correa de Serra). A hothouse evergreen shrub, allied to the lemon tribe. Linnæan class and order, *Decandria Monogynia;* natural order, *Aurantiaceæ.* Generic character: calyx four-toothed, cut at the base; corolla four-petaled, oval, sitting equal; stamens inserted on stipiti, in one brotherhood at the base, equal; anthers oblong, recurved; pods stipitate, oblong, two-valved; style persisting on the apex. This plant is called *Peritoma* by Sprengel.

ATALANTHUS (D. Don). A greenhouse undershrub from Teneriffe; it was previously known as *Prenanthes pinnata.*

ATELES (unfinished or incomplete, sometimes called "four-fingered monkeys"), a genus of four-handed mammalia, which have received that name on account of the thumbs of the fore feet being in general concealed under the skin, though there are two species which have very small rudimental ones, consisting generally of a single phalanx, and without any nail. They are all natives of America, and form a division of the American monkeys, or, as they are often called, *Sapajous.*

The animals of this genus form a tolerably well-marked group, peculiar in their haunts, their appearance, and their habits. They inhabit the wooded parts of South America, the interior of Guiana, Brazil, and generally the forests of all the tropical parts of that continent. One need hardly say the unfrequented forests, for, except a few Indians in the more open places, near the banks of the streams, those forests are all unfrequented by man, and many of them, by their depth and entanglement, to say nothing of the pestilent vapours which arise from them, are impervious to Europeans. It is not, however, in the very luxuriance of the swampy forests, where the exuberance of nature appears absolutely to run wild, and where, what with the ample foliage of the trees, what with the multitude of curling, climbing, creeping, and other parasitical plants, the vegetable canopy is so dense, that a twilight gloom rests upon the surface of the earth, even with a vertical sun at mid-day, that the animals of this genus are chiefly to be found. Forests of the character just noticed are the proper pastures of the sloths, which remain among the small twigs, feed on the leaves, and range but little from tree to tree, or even from branch to branch. The Ateles, as is the case with almost all the quadrumana, live chiefly upon fruits; and that being the case, they must have forests of such a description, as that, while they are below among the branches, they may have openings and light to enable them to see and examine the fruit-bearing part of the tree. Hence they are found chiefly on what may be called the middle grounds of the forest, the rich slopes, which lie between the highly fertile but rank flats by the waters, and the dry uplands, where the forest begins to straggle into the waste which bears no timber, or brushwood only.

These places are not only the best for the peculiar action of the quadrumana ; they also are their richest pastures, as fruit-bearing trees grow more readily and abundantly on those slopes than either in the rank hollow or on the dry height. In these parts of the forests there are many openings, and the trees generally stand more apart from each other, are lower in stature, more spreading and branchy, and less loaded with parasitical plants than farther down. Hence the animals which live in them require to be more active in their motions than the sloths.

In the trees, the Ateles are peculiarly active, especially in getting from branch to branch, and from tree to tree, sometimes to considerable distances. For these purposes the animals are admirably formed, as admirably as the long-armed apes of the Oriental isles are for their upward climbings in the spicy forests of those delightful regions. The four fingers, seizing and holding as a hook, are better adapted for motion generally oblique or lateral than hands with thumbs. But the Ateles have a fifth prehensile organ, and one which is perhaps more efficient in their march among the trees than any of the others. That organ is the tail, which in this genus is perhaps more prehensile than in any other. It is long in all the species, and in some it is twice the length of the body. The under side of it, towards the tip, is naked of hair, and covered with the same species of skin which covers the insides of the fingers, and generally all those parts of animals which are fitted for grasping. This tail can take hold very quickly, and it retains its hold more firmly than any hand ; so that, suspended by it, the animal can swing itself fairly round a branch, vibrate like a pendulum, and by putting the branch into a vibratory motion along with it, command a space of considerable extent.

The tail of these animals has sometimes been compared to the proboscis of the elephant ; and they who have made that comparison have inferred, not from the facts as observed, or from the structure of the organ, but from their own hypothesis, that it is used for similar purposes ; that the animal uses it like a hand in lifting little detached substances, in conveying fruits to its mouth, and in all purposes which it requires, analogous to those performed by the trunk of the elephant. But there is in truth no proper analogy between the two organs, either in structure or in use. The proboscis of the elephant is an organ wholly without bones, capable of flexure in all directions, and also, within certain limits, of lengthening and shortening. It is hollow, and at the extremity it has a grasping apparatus, answering some of the purposes of a hand, which can act with nearly equal facility in all positions of the rest of the trunk. Thus the proboscis not only acts as a hand, but in some instances it can be made to act as two hands. But it acts as a hand only; and though the elephant often makes use of it for pulling down those branches of trees which it cannot otherwise reach, it never suspends its body by it, or uses it in climbing. The tail of the ateles, on the other hand, is an organ having a bony vertebra for its basis, incapable of lengthening and shortening, having its powerful grasping action in one direction only, and having no substitute for a hand at the extremity. It is an instrument for laying hold, and in that way both a powerful and a ready one ; but it is not fitted for lifting loose substances, and there is no evidence that the animal ever uses it for such a purpose, either in carrying food to the mouth, or in any other way. The animal climbs by means of the tail, suspends and swings itself by means of the tail, and uses the tail to steady it in its most ungainly attempts at walking ; but it does not use the tail in feeding, or in any way in lifting or moving about loose or detached substances. It seizes with the prehensile portion of that only such objects as are firm, and it does so in order to maintain its stability.

None of the genus are handsome animals. They have a facial angle of about 60°, a large round head, a large and prominent abdomen, long and slender limbs, and a very long tail. The joints of their limbs appear as if they were more loosely put together than those of almost any other animals, and hence they are very awkward when upon the ground. Their limbs are, in fact, organs of suspension rather than of support, and therefore, when they attempt to use them in supporting the body, they are awkward, because applied to a purpose for which they are not formed. The motion of the sloths along the ground is very slow, and effected with no small difficulty and labour ; but the legs of the sloths are short, their bodies being near the ground in walking, and therefore their march does not appear so painful and unnatural as that of the ateles.

The legs of the latter are abundantly long, but they will not come into any thing like even tolerable marching order. The joints will not be firm, and the palms, the points of the fingers, or any part that would afford a base, will not apply to the ground. The only parts that will apply to the ground are the inner edges of the fore feet and the outer edges of the hind ones ; so that the animal shambles away, with a constant tendency in the fore legs to get too wide apart, and in the hind legs to plait over each other. The looseness of the joints makes the walk appear more awkward than it is, and the reality is awkward enough ; and the awkwardness is farther increased, by the animal attempting to seize with its prehensile tail all objects that seem capable of helping it on, or steadying its course. Walking upon the ground is not, however, the element of the genus ; and though they often descend from the trees to loiter and repose, their marches along the surface are always as short as possible.

But when in the trees, they are just as much in their element, and at home, as they are out of their element upon the ground. That flexibility which unfits them for the one situation, is a positive advantage in the other. The plaiting legs, the wide spreading arms, the flexible joints, and the long prehensile tail, enable them to seize and maintain their hold in situations where animals of more compact and better knit frame could not. The distances to which they can reach, and the certainty with which they take hold, even when they have to appearance been flung some distance through the air, and are falling, are truly admirable ; and when seen in a state of activity in the branches, they seem among the most energetic and the most sure-footed of animals.

Most of the species, if not all of them, are social, attached to each other, and apparently mild and inoffensive in their dispositions. They have none of the gambolling and friskiness, and none of the mischievous habits of common monkeys. It does not appear, indeed, that even in their most abundant pastures, they lavish much of their energy in sporting. Their excursions in the trees are chiefly in quest of food; they make them in the early part of the day, and by the time that the sun is high, and beats strong on the ground, they descend and bask themselves in his heat.

In the more distant and secluded parts of the forests, these animals associate in considerable numbers, and they are said not only to live in perfect harmony, but to make common cause against an enemy, and even against man himself,—if the attacks of the Indians, whose food, in some places, consists in considerable part of the flesh of monkeys, has not taught them, that when man appears it is safer to fly. The allegation is, that they combine to pelt the intruders with sticks and other missiles; but there have been so many stories told of the pelting propensities of quadrumana in other places, without any foundation, that this account of the ateles must be received with caution. When tamed, they are timid animals, and though the tamed ones will bite, it appears to be rather through fear of being injured than from any direct purpose of injuring.

If when they are hunted, or otherwise attacked, one happens to be wounded, all the rest scramble off for the trees, gain the tops as fast as they can, and then set up the most dolorous howling. The wounded one, if able, follows, at least as fast and as far as it can; and having gained a high branch, it coils its prehensile tail two or three times firmly round that, and then putting its fore paws to the wound, it examines, and appears to mourn over the flowing blood. All the quadrumana, however, have a similar habit when wounded; and though the expression is no doubt piteous, as all the order howl and lament, even when there is very little the matter with them, the affecting character of the spectacle has probably been exaggerated.

There are eight species in the genus or group, six of which are wholly without apparent thumbs on the forepaws, and the other two have them merely rudimental. They vary in size, colour, and locality, and the same species is described as sometimes differing considerably in different places, but their habits are all nearly the same.

The six species entirely without thumbs on the fore-paws are: 1. The Coaita (*Ateles paniscus*); 2. The black Coaita (*Ateles niger*); 3. The Marimonda (*Ateles Belzebuth*); 4. The Chuva (*Ateles marginatus*); 5. The Spider Monkey (*Ateles Arachnoides*); and 6. The black handed Coaita (*Ateles melanochir*). The two which have rudimental thumbs on the fore-paws are: 7. The Miriki (*Ateles hypoxanthus*); and 8. The Chameek (*Ateles subpentadactylus*). From what has been said of their haunts and manners, and the comparative uniformity of these, the notice of the species may be brief.

The *Coaita* is pretty widely distributed, being found both in Guiana and in Brazil. This is perhaps the best known of all the species, and is the one usually referred to by the name of four-fingered monkey. Coaita is its name by at least some of the Indian tribes by whom it is hunted, and that under which it is described by Buffon. It is probably, as the most of such names are, a sort of imitation of its cry. The length of the body is not above fourteen inches, while that of the tail is fully two feet; the limbs are long in proportion to the body, slender, and jointed in the loose manner that has been described. The face is nearly naked, and of a flesh or copper colour; but all the rest, with the exception of the under part of the tail toward the point, is covered with black hair. In the woods of Guiana these animals are found in numerous parties, generally hanging suspended from the branches of the trees, and rarely upon the ground, where they have very little command of themselves. They are quiet and inoffensive, and not difficult to tame; but like all the rest of the quadrumana, they are perfectly useless. It cannot well, indeed, be otherwise; because their native haunts are so unlike places which man generally inhabits, and their natural actions so unlike anything which man requires to have done, that their nature would have to undergo a total change before they could be in any way useful.

The Spider Monkey and Black Coaita.

The *Black Coaita*. This species has hitherto been seen only or chiefly in Guiana. In many respects it has a considerable resemblance to the former, and has been sometimes considered as a variety; but the face, instead of being copper coloured and naked, is uniformly black and covered with hair.

The *Marimonda* is also found in Guiana, and appears to be rather a local species. It is about the same size as the two former; but it has some peculiar markings. The hair on the head turns backward from the front, and forward from the occiput; and the two meeting together form a sort of prominent ridge or crest across the middle part of the head. The hair on the back is black; but that upon the belly and under part is dull yellow in the old males, and white in the females and the young. There is a flesh-coloured circle round the eyes, which, with the crested ridge of hair on the top of the head, gives it a peculiar expression. These animals are found associated in considerable numbers, and when they descend from their labours on the trees to bask themselves in the sun, they are said to express their regard for each other with somewhat ludicrous affection, embracing, shaking hands, and paying such other compliments as monkeys can pay. After salutation is over, they are said to lie down upon their backs, with their open eyes to the sun, and fling their long and ill-jointed limbs as carelessly beside them as if they were to be of no more use. In this way they spend the heat of the day, unless an enemy appears, in which case they gather to them their lumbering legs with all possible expedition, and make for the trees as fast as ever they can, swinging and bounding from branch to branch with an alacrity which forms a striking contrast with their indolence and relaxation while basking in the sun.

The *Chuva*. The most remarkable character of this species is a border of white hair round the face, from which it gets the name of *marginatus*, or "bordered." The hair on the rest of the body is black. This species inhabits further into the interior of the continent than those already mentioned; but still it is found only in the woods.

The *Spider Monkey* appears to have obtained its name from the length, slenderness, and pliancy of its limbs, though in these respects it does not appear to differ much from the rest of the genus. Indeed, all the species are so similar in their habits, that the only differences are those of colour. The covering of this species is yellowish grey, much softer and approaching nearer to the texture of fur than that of the others; but it has long black hair above the eyes.

The *Black-handed Coaita* has the back part of the head, a patch on the outside of each knee, and the extremities of all the limbs, black or dark brown. The rest of the body is of a uniform grey colour.

The *Miriki* has a mere rudiment of a thumb on the fore-paws, generally without any nail, though sometimes with a rudimental one; but both nail and thumb are so exceedingly small that they can answer no very efficient purpose, and they do not in any way act against the fingers. The colours of this species are rather more diversified than those of any of the others. The face is flesh colour, but spotted over with grey; the buttocks and basal part of the tail are rusty yellow, and the rest of the body is yellowish grey. This species has been found only in Brazil.

The *Chamuk* has projecting thumbs on the fore-paws, but they are very small and short, consisting only of one little paw, and without any nail. The colour is nearly uniformly black. This is also described as being a Brazilian species, and not found in the countries much further to the west.

It has sometimes been proposed to form the two species last mentioned into a separate genus, on account of their having rudimental thumbs; and, certainly, small and inefficient as these members are, these species are not strictly four-fingered; but still the foundation is a very narrow one on which to institute a genus.

The females of all the species have two pectoral mammæ and the young support themselves by clinging with their long and spider-like limbs, thus leaving the mother the free use of hers; and they cling with security while she bounds and swings. It is rather curious that this genus, which are among the worst walkers of all the footed mammalia, not only on two legs but on all fours, are the only ones that have the biceps muscle of the thigh the same as in man.

ATEUCHUS (Weber). A genus of coleopterous insects belonging to the family *Scarabæidæ*, having for its type the sacred beetle of the Egyptians, and comprising several distinct subgenera. Mr. MacLeay, in his *Horæ Entomologicæ*, has, however, considered that the name of Scarabæus having been originally employed to designate these sacred insects, ought to be retained for the genus, whilst to the subgenus containing the true sacred beetles he has restored the original term of Ἡλιοκανθαρος, Heliocantharus, or beetle of the sun. This system of nomenclature we propose to adopt, and shall therefore detail the economy of the insect under these heads, mentioning it in this place only because continental naturalists employ the nomenclature of Fabricius who adopted that of Weber.

ATHALIA (Leach). A genus of hymenopterous insects belonging to the family of the *Sawflies* (*Tenthredinidæ*). The wings have two marginal and four submarginal cells; the antennæ are described by Dr. Leach to be ten-jointed, but in reality there are eleven articulations, the three terminal ones forming a mass: the third joint is the longest. The perfect insects are of small size, inhabit flowers, and are fond of resting upon the young stems of plants; they are slow in their motions, and instead of flying away when approached, they fold their antennæ beneath the body and drop from the twigs. Their colours are for the most part black and buff, or yellow. There are five British species, the *Tenthredo rosæ* of Linnæus being the type.

ATHAMANTA (Linnæus). A genus of thirteen species, chiefly perennial herbs, natives of Europe. Linnæan class and order, *Pentandria Digynia*; natural order, *Umbelliferæ*. Generic character: involucrum often of many leaves; fruit oval, solid, rough, or woolly, five-ribbed.

ATHANASIA (Linnæus). A family containing seventeen species of evergreen shrubs, introduced from the south of Africa. Linnæan class and order, *Syngenesia superflua*; natural order, *Compositæ*. The genus is arranged in two sections, viz., with entire and with divided leaves. The flowers are yellow, and very lasting.

ATHERICERA (Latreille). One of the primary divisions of the dipterous order of insects, comprising the Linnæan genera *Conops Œstrus*, and the majority of the genus *Musca*, or the modern families *Conopidæ*, *Œstridæ*, *Syrphidæ*, and *Muscidæ*. The insects composing these families have the mouth enclosed in a cavity; the antennæ have only two or three joints, the last of which is furnished with a bristle, and the rostrum, haustellum or proboscis is membranous, long, and elbowed in the middle, with two fleshy lips at the extremity, and bearing two palpi behind the angle. It is furnished with two or four instruments for piercing the food. The larvæ have the body very soft and fleshy, contractile, annulated, and pointed towards the head, which is of a variable figure, and furnished with one or two hooks, accompanied by fleshy mamillæ, and probably in all by a sort of tongue, destined to receive the fluid matter serving for the nutrition of the insect. These larvæ do not cast their skin, nor undergo the usual moultings of larvæ: indeed this is carried so far, that the skin of the grub, at the period of the insect's assuming the pupa state, hardens, becomes shorter, and serves as a covering for the enclosed pupa; the pointed front increases in size until the whole assumes an oval form, whence the pupæ of these insects have been compared by the early French naturalists to "une boule allongée." The families may be thus arranged:—

1. Mouth with four piercers . . Fam 1. *Syrphidæ*.
2. Mouth with two piercers:
   1. rostrum obsolete . . . Fam. 2. *Œstridæ*.
   2. rostrum exserted and long Fam. 3. *Conopidæ*.
   3. rostrum retractile and short Fam. 4 *Muscidæ*.

ATHERINA—Atherine. A genus of spinous-finned fishes, belonging to Cuvier's *Mugiloides*, or mullet family, or rather intermediate between them and the *Gobioides*, but not strictly belonging to either. The species are numerous; and the individuals are also numerous on those places of the shores and estuaries which they frequent. They are of small size, but very delicate flavour, on which account they are in much request for the table; and, as they throng in shoals very close together on their favourite stations, they can be caught in great numbers.

Their general characters are: the body elongated; two dorsal fins considerably apart from each other; the ventral fins placed in advance of the pectorals; their mouth is protrusile, and the teeth very small and standing apart from each other; they have six rays in the gill-flap; and all the species are marked with a silvery band along each side.

There are various species in the European seas, the greater number of which are found in the Mediterranean; and they are inhabitants of the warmer seas rather than the colder. There is at least one species, however, which is found on the Atlantic shores of middle and southern Europe. This species was confounded with some of the others by Linnæus, Bloch, and various other naturalists, who probably had no opportunity of examining the fishes themselves; and the error has been continued by most British writers or compilers on the subject. The name given by Linnæus is *Atherina hepsetus*, which Cuvier is of opinion is a Mediterranean species; and he gives the name of *Atherina presbyter* to the species found on the shores of the Atlantic, from the bright silvery bands having something the appearance of a stole. This species is found on some parts of the south coast of England, especially near Southampton, where it is the Atherine (*A. hepsetus*) of most describers, while the local name is the smelt. Both are wrong; for the true smelt is a soft-finned fish, nearly allied to the sea trouts, and growing sometimes to three times the length of the atherine. The smelt is also found much farther to the north than the atherine. It resorts to the estuaries of rivers for the purpose of spawning; and, like the white bait and some other species, keeps the middle of the brackish water. The white bait has been described by many as the young of the smelt, which is singular enough, as smelts resort in shoals to spawn in estuaries where a single white bait is never found, and white bait are found where there are few or no smelts.

The atherine which is found in the English Channel is not more than four or five inches in length. It is yellowish brown on the upper part, with small dark spots on some of the scales. The under part is silvery; and the silvery bands on the sides are very conspicuous. The head is depressed, and has a mesial ridge: the greater part of the body is semi-transparent. These fishes are understood to spawn about midsummer; but they are caught at almost all seasons, except when the weather is very cold and frosty.

On the shores of the Mediterranean they are still more numerous, and sought after with greater avidity; but the species are different. All the European species are readily distinguished by the number of rays in the fins and of vertebræ in the skeleton.

Atherina hepsetus of Cuvier, the *sauclet* of Languedoc, and the *cubassou* of Provence, has nine spinous rays in the first dorsal fin, and eleven soft ones in the second; the anal fin has twelve rays; and there are fifty-five vertebræ in the spine. The muzzle is rather more produced and pointed than in the other species.

Atherina Boyer of Resso, the *joël* of Languedoc, has the head shorter and thicker than the last species, and the eyes larger in proportion. It has seven spines in the first dorsal, and eleven soft rays in the second; the anal has thirteen soft rays, and there are forty-five vertebræ in the skeleton

Atherina mochon (the *mochon*) is like the sauclet in general appearance. It has seven spines in the first dorsal, fifteen soft rays in the anal, and forty-six vertebræ in the spine.

In size, in general appearance, and in the quality of their flesh, the European species differ but little from each other. Nor does it appear that there are any very great differences among those of other seas, which are numerous, and found in various parts of the world.

ATHERIX (Meigen). A rare British genus of dipterous insects, belonging to the family *Rhagionidæ* of Leach: the antennæ have the basal joint larger than the second, and thickened, at least in one of the sexes; the third joint is transverse; the proboscis is not so long as the head, and porrected. These insects, which have much the appearance of the common flies, may be at once distinguished by the much greater number of nerves and cells in the wings. They are generally found in the neighbourhood of woods, and the sexes are very dissimilar. Mr. Stephens records four British species, of which the *Ath. marginata* has been figured by Donovan, pl. 549, under the name of *Musca Atherix*.

ATHEROSPERMEÆ. A natural order of plants, containing two genera, *Atherosperma* and *Pavonia*, and about twenty species. It has only lately been recognised by botanists as a separate order. By some the genus *Atherosperma* is still referred to the *Urticeæ*, or nettle tribe; and the genus *Pavonia*, to the *Malvaceæ*, or mallow family. The essential botanical characters of the order, as separated from all others, are: flowers hermaphrodite or unisexual; calyx tubular, divided at top into several segments, which are usually placed in two rows; stamens, in the male or barren flowers, numerous, inserted in the bottom of the calyx, in the hermaphrodite or perfect flowers arising from the orifice of the calyx; anthers two-celled; ovaries more than one; styles and stigmas simple; nuts terminated with the style, which remains in a feathery state after the flower withers; seeds solitary.

This order consists of trees or shrubs which are found in South America and New Holland. They have generally aromatic and somewhat stimulating properties, but their qualities are not much known, and only a few of them are applied to any use.

The *Pavonia odorata* has a sweet pleasant-smelling root, an infusion of which is used as a diet-drink in fevers by the Hindoos. The root of the *Pavonia Zeylanica*, a native of Ceylon, is also used for a similar purpose.

ATLAS. Lesueur was the first to constitute this genus from the *Atlas Peronii*. It does not appear entirely known; but, nevertheless, ought properly to belong to the same family as that of *Gasteroptera*, The body of this marine animal is divided into two portions, united by a kind of peduncle, somewhat similar to the gasteroptera, the posterior is oval, the anterior circularly dilated, and ciliated at its edges, but provided with a very small distinct foot beneath, with a pair of very small ear-shaped tentacula above; the vent is in the middle of the right side of the posterior mass. The organs of respiration are unknown. De Blainville places this genus in the family *Akera*, of the order *Monopleurobranchiata*, class *Paracephalophora*. The only species described is Peron's *Atlas*.

ATMOSPHERE. The mass of invisible, transparent, and dry fluid, which surrounds the whole globe, and forms not only the grand natural medium of communication between the land and the waters, but the medium by which the remotest points on the whole surface are enabled to communicate with and be of use to each other.

It has been already stated in the article AIR, which see, that the mechanical and chemical properties of this fluid form no part of natural history; and some of its local uses to plants and animals have been pointed out in that article. The fact is, that the atmosphere is so very important, and the uses of it, both in nature and in art, are so many, that the entire knowledge of it forms many sciences, and some of the applications of those sciences are of vast importance in the arts of life. We may remark, in passing, that it is to the atmosphere that man owes his first and grand triumph over all the other animals. He kindles a fire, and all the savage tyrants of the world avoid its radiance, as if it were the contrivance of powers superior to theirs. This fire once obtained, the uses of it are innumerable, and yet the half of them may not have hitherto been discovered. Without it, we could dress no food, we could have no metals, no glass, no porcelain, no bricks for building, no steam, no gunpowder, nothing, in short, worth the living for; and we could have no fire without the atmosphere. Yet this is but one of its numerous uses, and what we are sometimes disposed to consider a trifling one; at least it is of so very common and familiar a nature that we are apt to pass it over unheeded. Our acquaintance with the weather, too, on which our comfort, our health, and well-being rests, so far as we are cultivators or dependent upon cultivation, (and who is not either the one, the other, or both?) are so much involved, is wholly a matter of the knowledge of the atmosphere. The uses of the atmospheric fluid as a power, whether in the turning of mills and other machinery, the wafting of ships across the seas and oceans or quite round the globe, or any other purpose, to which as a power it can be applied, are well worthy of our study and our admiration. In these respects, it is both a wonderful and a wayward thing; and judging of it according to our plans and wishes, we may say in the language of Holy Writ, "the wind bloweth where it listeth." But when we take all nature into consideration it is not so; for the blowing of the wind is an effect, a natural effect, and is as dependent upon its cause and as proportional to it as any of those effects, over which and their causes, we suppose that we have the most perfect control.

The blowing of the wind, though not in itself simply, or in the notions that we have of it as a mechanical power, one of the natural history properties of the atmosphere, is yet one which tends very naturally to produce these, because it is the mobility of the atmosphere, or the ease with which it is put in motion, which is the foundation of many of the most important functions which it performs in the economy of nature.

In the economy of the earth's surface, and as far below that surface, whether it be land or water, as life and growth are concerned, the atmosphere may be considered pre-eminently above every other agent, as the *messenger* by whose kindly offices the system of nature is preserved, and but for which every living thing must, as a necessary result of those common laws of matter which are still as necessary to the perfection of the whole, as the agency of the atmosphere is, speedily and inevitably perish. Whether, if there were no atmosphere, water could exist upon the surface of our earth, is a question which we are not, in a merely natural history view of the matter, called upon to decide; but analogy points rather to the negative; and some persons believe that we have, in the body which is situated the nearest to our earth, the *moon*, an example of an atmosphereless and waterless globe. We cannot examine the surface of the moon, close at hand, and with our naked eyes, as we can do that of the earth along which our path lies; but science, by furnishing us with the telescope, gives us some advantages in examining the moon, which we cannot have in examining the earth. The portion of the earth's surface which our vision can in ordinary cases command, is a mere speck as compared with the whole; and when we ascend to the utmost elevation to which a balloon has floated, or the foot of man trod the mountain, and take with us there the very best instruments which human ingenuity has constructed, our horizon is still very limited, and though (of which we can have no security) the clouds favour our observation, all that we can by possibility see, gives us no adequate idea of what the globe which we inhabit is like, in all its lands and seas, and all its zones and climates, with their varied productions.

But when we examine the moon through an instrument of sufficient power, we can judge of it as a whole, that is we can command, wholly or nearly, an entire hemisphere, or half of its surface. It is true that we do not see the entire hemisphere in the same position: we see the centre of it in plane, and the rest more and more obliquely, till the parts at the circumference are seen in profile. But this is a very great advantage; because we have planes, elevations, and also views in all degrees of obliquity, the information which we get from each of which, corrects and perfects that which we get from the others. Not only this; but in the course of the waxing and waning of the moon, from the first streak of illuminated surface that appears a little after sunset in the west, to the last vanishing one which appears a little before sunrise in the east, we have the light falling upon the same portions of the surface at a great variety of angles, and thus revealing them by all the advantages of light and shade, which are most essential elements in the judgments which we form of objects on the earth from sight.

The 240,000 miles which the moon is, on the average, distant from the earth, is, no doubt, a long distance, although not more in absolute length than that passed over by a sailor, who makes ten or twelve voyages to India. But to the eye it is really nothing, for the eye can see a star so far off, that 200,000,000 of miles is not a measurable fraction of the distance. The distance of common vision, and the distance of the moon, is therefore a question of the relative magnitude of surfaces equally visible; and it is not overstraining the fact to say that, with the very best instruments, a portion of the moon's surface ten miles square, nay, *one mile square*, may be seen as minutely in proportion to its magnitude, as a surface *one inch square* can, by the naked eye, at the distance of one foot.

We have stated somewhat at length the command which observation has of the surface of the moon, for two reasons: first, because the subject is not, so far as we are aware, mentioned by any writer on natural history; and secondly, because the consideration of it is most essential to the accurate formation of those enlarged views of nature, which are equally essential to the full perfection of the science, and of the lesson of moral and intellectual wisdom, which it is so admirably calculated to afford. No one who observes merely species, if there is in him any speculation at all, can fail to notice how much the habits, and even the forms and structures, are dependent upon the localities of which they are natives, and especially upon the degree and distribution of humidity and heat in these localities.

Now, the object of this article is to show that the atmosphere is the grand agent in regulating both the degree and the distribution of these, especially of the humidity; and therefore we cannot start so as to bring out the full force of its advantages, unless we start with the consideration of a surface which has no moisture to be distributed, and no atmosphere to act in its distribution. On the earth we have no such surface. The atmosphere is every where, and no where altogether without heat and moisture. The genial influence of the sun, borne upon the wings of the ever-stirring atmosphere, acts upon the mountain snows and the polar ice; and, even upon the most dry and thirsty deserts, the dew of heaven descends, and in the season, the rains invade their margins and refresh their oases with fertility. The one and the other are parts of the system of nature, brought into action by the agency of the atmosphere; and though in themselves they are at variance with our common notions of productiveness, we know not the advantages which they may confer upon our own fields and their productions. It may be (and there is more than an idle supposition in the idea), that, but for the dry surface of great part of Africa, the north wind would not blow in winter, and consolidate our vegetable tribes into their hybernal repose, but that through that period of the year they might have their strength exhausted by a sickly action during the day, which should be destroyed by the cold of each succeeding night; and it may be, too, but for the seasonal action upon the " regions of the thick-ribbed ice" in the summer, the soft south would not waft us its heating breezes and its fertilising showers. Such questions are beyond the present state of our knowledge; but as we can take no part of the surface of our globe out of the general system of nature's working, so we are unable to say what part each does or does not perform in that grand system. In the common accounts we find such a proneness to exaggerate, that we ought to pause before we give credence. According to these, the thirsty desert is the region of death; and the " simoom" not only kills, but instantly disjoints and dismembers the slain. But, according to the evidence of those who have been exposed to it, in those places where it is usually represented as being the most fatal, the simoom is misrepresented—calumniated. There is no pestilence in it; and though it scorches with drought, and is mechanically annoying from the clouds of sand which it raises, there is nothing deathly in it; and it *may* be the means of diffusing the elements of health over those very places where it rages in the utmost of its fury. Nowhere on the earth's surface do we find the abandoned spot—the place where the goodness of the Creator is not manifested; and if we imagine that there are any where the elements of ruin, we find that He hath " fenced them in with gates and bars " which they cannot pass. We find the barrier set—the confine traced, by

> " The golden compasses, prepared
> In heaven's eternal store, to *circumscribe*
> The universe, and *all created things*;"

so that all may " work together for good."

Therefore, we must look elsewhere for the total absence of the elements of life, growth, and enjoyment; and we find that dreary state of things in the moon. What may be the use of that luminary in the economy of general nature, besides the light which it reflects upon our earth, and the oceanic and atmospheric tides which its attraction produces, we have no means of ascertaining, because we are unable to cross-examine by any evidence of sense or judgment of reason, the appearance which it presents to the eye, aided by the telescope. But that sight is not simply melancholy, it is awfully appalling, and outrivals all that fancy has delineated of the regions of woe. Seen through a glass of even moderate power, the nearest comparison to the places of it upon which the light falls obliquely, is a piece of half-melted snow, which is honey-combed by the action of the weather, but from which the water is clean gone, and there is no earth in the interstices upon which fertility can in any way display itself. But when we apply the requisite power, the sight is truly appalling; large blisters, of which the margins stand up rugged for a mile, are many miles in circumference, and the depths of the pits fearful; plains of solid matter furrowed, as if chaos had been fixed in death in the wildest of its turmoil; single angular rocks, rising to the altitude of our mountains, with crystals, hundreds of fathoms in length, projecting horizontally from their rugged and perpendicular sides; and angular fragments flung together at their bases, each rivalling a hill in magnitude: —these, these are the visible features of the surface of a globe which contains no water, and is surrounded by no atmosphere. Of course, upon such a globe, there can be no plant and no animal at all resembling those which are found upon the earth; and indeed we must entirely alter our notions of life and growth, before we can imagine that there is either the one or the other there. Compared to such a globe, the most dreary parts of the earth have all the charms of a paradise; and they, in no small degree, owe those charms to the agency of the atmosphere.

But when we consider the state of the surface of our own planet, and the various species of action of which it is the theatre, we cannot fail in being convinced that, but for the agency of the atmosphere, it would speedily become desolate, even leaving out of view its essential necessity for the lives of plants and animals, as shortly explained in the article Air. Much of the surface is covered by water, but from the saline ingredients with which that water is mixed, it is, even if we were to suppose that it could, by some mechanical means, return *en masse* to the land, wholly unfit for land plants and land animals. Those salts are ultimate chemical products—sulphates, chlorides, and hydro-chlorides, beyond the ordinary powers of living action to decompose, or even to separate the water from them in its wholesome and limpid state.

And even if the ocean were as pure as a fountain, or as soft as the rain-drops from a cloud, without the atmosphere, there are no means of bringing it on the land. The law of gravitation which, working in concert, works so powerfully for life, would, working alone, work just as powerfully for death. The spring empties itself into the brook, the brook into the river, and the river into the sea ; and if the sources were not supplied, the whole would run dry in a single season. If it were not for the atmosphere, the tops of the mountain ridges, which now collect the rains, and store up the snows, the melting of which refresh and preserve the valleys in the season of drought, would be the hottest, and for that reason the driest, portions of the whole surface ; and were it not for the atmosphere, the sun, wherever it shone, would be hotter than it now is when its beams fall perpendicularly upon the plantless *karroo*, in the sapless sand, while every night would have the darkness of Erebus, and a degree of cold more intense than that of winter in the extreme north of the American continent; so that the change every twenty-four hours would be that from a cinder to an icicle, or even greater. Nothing could, in such a state, live or grow; nay, the very rocks themselves would yield, and the strength of granite would be mouldered to dust. All would speedily sink to one sad level, and from that level there *could* be no return. These would be necessary results, proceeding from the very nature and constitution of matter, and it is in consequence of the atmosphere preventing them, that the study of it becomes so important to the philosophic naturalist.

And though at times it kindles the lightning, awakens the thunder, and lets loose the tempest and the hurricane, these are but local as well as temporary; and its grand and general action is as gentle and silent as it is beneficent. Its simplicity is its strength, and its power of being so very beneficial arises from the readiness with which it yields to even the simplest impressions.

The constituent parts of the atmosphere, by being in the state of gas, have all their powers, or attractions, of cohesion, completely subdued and neutralised; and they are simply mixed together, so that, as already stated in the article Air, the portion which it requires can be separated by the weakest creature without any effort. This simplicity of constitution renders the atmosphere all obedience to every cause that acts upon it, and enables action begun at one point to be propagated throughout the whole; as, for instance, the intense heat which is produced by the sun beating strongly on one place, is speedily diffused to other places; and the clouds which are drank up by evaporation from humid places, steal their way silently through the obedient atmosphere, till they ultimately descend in refreshing showers upon the thirsty land.

The cohesion of the atmosphere being perfectly subdued or suspended by the heat which maintains it in the gaseous state, it has a tendency to distribute or diffuse itself equally in all directions, unless it be restrained or prevented by pressure. When in a tranquil state, or equally at rest over the whole surface of the globe, it is subjected to only one pressure, the pressure of gravitation towards the centre of the earth, which is at once the proof of its existence and the measure of its quantity as matter. At any point on the surface this pressure acts perpendicularly; and at the mean level of the sea it is on the average balanced by, and therefore equal to about 29 inches of mercury, or 33½ feet of water, which is nearly 15 pounds on the square inch. But as the atmosphere is a perfect fluid, it yields equally in all directions to pressure, and thus it presses every way, laterally and upwards, with the same force as it gravitates downwards. By this means, it enters and fills the smallest pores and openings in all bodies; and while its perfect fluidity admits of the most perfect freedom to all their motions, it bears them up with a very effective support, as if they were equally propped at all points. Upon the surface of a human body of the average dimensions, the pressure of the atmosphere is about fourteen tons and a half, but so perfect is the balance on all sides, that this weight, while it renders the whole body stable, instead of rendering progressive motion more laborious, does not impede the pulse of the minutest artery. All animals and plants are supported in a very wonderful manner by this atmospheric pressure, which gives them solidity, and yet hinders none of those actions which are necessary in their economy.

Its insinuation into the minutest pores and openings also prevents the surfaces of bodies from adhering or sticking together, and the thinnest pellicle answers this purpose. Were it not for this property of the atmosphere, the consequences would be serious : the taking off of a man's clothes would be a much more laborious matter than the flaying of a bullock ; and if we suppose that the sole of the bare foot, when planted on the ground, and bearing the weight of the body, touches with only 12 inches of surface, then the foot would be held to the ground with a force of 180 pounds, or it would lift along with it a stone of about a cubic foot. The stone, however, would, as presenting a larger base, adhere to the ground with much more force, and the foot would remain fixed to it. Thus we see that, without one of the most simple properties of the atmosphere—a property which, in our common observation, we overlook,—there would literally be no motion in the world.

The pressure of the atmosphere can be estimated in height of air, as well as in height of mercury or of water. At the ordinary temperature and pressure water is about 820 times heavier than air; and therefore 27,470 feet in height of air will balance or be equal in weight to 33½ feet of water. This, allowing for the inequalities of the earth's surface, would give to the atmosphere, supposing it equally dense at all elevations, a height of about 1500 or 2000 feet above the top of the very highest mountain on the globe.

But the atmosphere cannot have the same density at all elevations, because its density is owing to its own weight only, or rather to the excess of its weight above its expansive tendency or force. And as we ascend above the mean level, the pressure becomes less, not only because the height to the top of the atmosphere diminishes, but because the pressure thereby taken off allows the expansive force to act. It is evident that the expansive force, or the tendency to spread or diffuse, must be greater when the density is greater, and that it must diminish as the density diminishes. It by no means follows, however, that the two should diminish at the same rate. Indeed, it is obvious that the tendency to expand must diminish faster than the density produced by the pressure or weight; for if such were not the case, no part of the still atmosphere could be more dense than another, for the superior density of the lower strata can be produced only by the pressure overcoming, to a certain extent, the tendency to expand; and farther, if the pressure arising from the weight were not the greater, the expansive force would soon dissipate the whole atmosphere through the regions of space.

But though the pressure or gravitation of the atmosphere is as much greater than its tendency to expand as to prevent any part of it from being thus dissipated, yet the expansive force acts as the pressure diminishes, which it does as the height above the mean level increases, because the quantity of air over head becomes less the higher that we ascend, and the pressure or gravitation, being the measure of that quantity, must be equal to it in all its variations. Farther, as the density is the result of the pressure or weight, it must always be in proportion to that, or the rarity must be inversely as the pressure. The densities at different heights will, therefore, express the quantities of air in the superincumbent portions of the atmosphere above those heights, but not the heights upward to which they extend, or the total range of the atmosphere. That range is not, however, difficult to determine; for as the expansion must be as the diminution of pressure, and the increased action of the expansive force *jointly;* and as these are equal to each other, and each of them proportional to the height, it follows that the expansions or decreases of density will be as the squares of the heights, or conversely, that the heights will be as the square roots of the expansions.

In consequence of this increasing expansion with the height, the atmosphere occupies far more space, with the same quantity of matter, than if it every where maintained the density which it has at the mean level of the sea: we have shown that with that density it would have a height of only between five and six miles. But with the decreasing density it has, at the height of about 44½ miles, body enough so to act upon the light of the sun as to produce twilight. Beyond that, its range must be considerable; but in the extreme of its altitude, our knowledge of it is obscure, or altogether wanting, and the twilight may be taken as the most elevated natural proof we have of its existence; but, as that is an elevation which commands a horizon of about 2500 miles in diameter, or one at which a meteor over the centre of Europe could be seen from every point of that continent and its islands, we may suppose that it includes all appearances that can, with any thing like knowledge, come within the range of natural history.

The short view which has been taken of the mechanical structure of the atmosphere, in its simple state, and without reference to the action of any external agent or cause upon it, is necessary to be borne in mind, in order that we may have a proper understanding of the part which it performs in the operations of nature upon the grand scale. It must be understood to be, in itself, wholly passive; the ready and efficient medium of action, but not the cause. At all altitudes, the two forces which determine its density,—the pressure of gravitation and the reaction of expansion,—so exactly balance each other, that the smallest possible action of any other cause, will turn the scale either way; the smallest condensing agency will produce condensation, or the smallest expansive agency will produce expansion. Thus it is, to all the agents in nature, a medium always at hand, and always ready for action.

In estimating those two opposing actions by which the atmosphere is balanced, we have taken no notice of the centrifugal force arising from the rotation of the atmosphere along with the earth. We omitted that in order not to confuse the statement by the introduction of too many principles. The centrifugal force, as far as it goes, is an auxiliary of the expansive force; but in the case of the atmosphere, it diminishes with the height; for though it increases with the distance from the earth's axis, it is also in proportion to the quantity of matter in a given space, and therefore it diminishes in the same ratio as the density, so that in the higher regions of the atmosphere it must be very small.

But, upon the general principle that, under the same or similar circumstances, the resistance which the inertia of matter offers to any force acting upon it, is always in proportion to the quantity of matter contained in an equal space, it follows that the lower strata of the atmosphere must offer more resistance to the active energies of nature, than the strata which are more elevated, and for that reason less dense;—that, for instance, if we suppose the base of a mountain to be on the mean level of the sea, and the top to rise to a considerable height, the resistance of the atmosphere to any natural action, as, for example, to that of plants and animals, will be greatest at the base, becoming gradually less and less as the mountain is ascended, and be least of all on the summit. Water will boil sooner, a bud will expand sooner, and, generally, any operation will be performed in a less time, or with less effort, on the summit of the mountain than at the base; and, if the height be considerable, the difference will be palpable to common observation. At the Nitee Ghaut, in the Himalaya mountains, the barometer stands at about sixteen inches and a quarter, while, at the level of the sea, it is about twenty-nine and a half; and if the pressure upon the surface of a man's body, at the level of the sea, be fourteen tons and a half, that at the Nitee Ghaut will be barely eight tons, and the pressure on all other surfaces will be diminished in the same proportion. In the elevated situation, there will, in consequence, be a distension of the smaller vessels of the body. Upon the same principle, all expansive forces, in the growth of vegetables, the freezing of water, or whatever else acts by expansion, will act under less restraint of pressure, and, therefore, other circumstances being equal, the same effect will be produced with less exertion.

It must not thence be inferred, however, that the action of plants, or of animals, is rendered more energetic by the removal of atmospheric pressure, for the fact is directly the reverse. The power of action is determined by the resistance which it overcomes, and by that only; and if there be no resistance, the action of the power produces nothing, and amounts practically to nothing. Considering its mass and the rapidity with which it travels in its orbit, the power of the revolving earth is tremendous: so great that all the powers which we see or hear of upon the earth,—the descent of waters, the blowing of winds, the action of men and animals, steam, gunpowder, hurricanes, earthquakes, all combined, do not amount to a measurable fraction of it; and these occurrences affect it no more than a single dew-drop affects the ocean. Yet this tremendous power is silent and ineffective. The earth rolls on; but its motion never hurts the most delicate flower, or the most tiny insect, or interferes with the operations which are going on in the remoter and rarer portions of the atmosphere, where, probably, the millionth part of a grain in weight would affect the whole operations. But if, as it careers along, the earth were to meet with an adequate resistance, say with another globe of the same size and weight as itself, then though that globe were at rest, and thus merely passive, the collision would be even fearful to think on. What it would positively be we are unable to say, because we know nothing at all analogous with which we can compare it; but this much is certain, from what we know of the action of comparatively trifling powers when properly resisted, that it *could*, in an instant, dissipate both globes through the regions of space in viewless air, too thin for being recognised by any sense, or tested by any instrument. Many other instances might be given, but this one may suffice, the more so that any one who reflects, must be convinced that we have no knowledge of power but from the effects which it produces, that is, the resistances which it overcomes. The motion of the earth, the circulation of the blood in our own bodies, and countless other results of power that could be named, never would or could have been found out by any observation of simple facts; and the pressure of the atmosphere comes so much under the same denomination, that the discovery of it is considered as one of the most brilliant, as well as the most useful, in the whole wide field of modern science.

Thus we have, in what may be considered as the merely passive resistance of the atmosphere, a very general and very important power, or, to speak more correctly, an evolver of power, in all the actions of living and growing nature,—a power to which not a few of the differences which we find between the productions at different heights in the same latitude are owing. At the base of the mountain we find, for instance, the vine and the olive; on the middle slopes there are luxuriant forests; to these succeed heaths and other lowly shrubs of slow and creeping growth, then lichens, hardly more vegetable in texture or in taste than the rocks which they incrust; and, lastly, the never-thawing snow, even where the fire of a volcano blazes in the midst, and at times raises its pillar of flame, and volleys its red-hot rocks many hundreds of feet into the air. The variety of animals is as great, from the ox to the buffalo, which grazes in the rich meadow at the base, through all the succession of tribes to the marmot by the margin of the snow, which dozes out half its life in a state of hybernating stupor. The differences of pressure in the atmosphere are not the sole causes of these differences of the productions of the earth at different altitudes; but it is one of the causes, and one upon which some of the others depend; and it is a cause not arising from any action of the atmosphere, either mechanical or chemical, but from its perfectly neuter and quiescent state.

When the resistance of force, or, which is the same thing, of motion (for we have no notion of physical force unless in so far as it produces, or tends to produce motion), attains to a certain degree, it is always accompanied by the evolution of sensible heat; and this result is so constant, that we have no knowledge of the evolution of sensible heat but by the resistance of motion of some kind or other; and conversely there is probably no resistance of motion without an evolution of heat, whether that heat be cognisable by our senses or instruments or not. Of course it is impossible for us to have direct evidence in those cases which are too minute for our observation; but the fact of heat accompanying resistance, and being, unless in cases where we can easily explain the deviation, so exactly in proportion to the resistance, and in truth the measure of it is so general, so free from a single exception, that to suppose it does not extend to every case, whether that case come within the limits of our observation or not, would be a violation of the fundamental principle of all philosophic reasoning.

Here, then, we have another important result of the varying pressure of the atmosphere, as affecting the living and growing productions of nature at different heights above the mean level of the sea. The additional resistance which, in places that are situated low, it offers to the action of plants and animals, produces heat as well as more intense action; and from all that we know of the economy of plants and animals, both of these are essential to their development, and that development must increase with the increase of both, and diminish with their diminution. Thus we see that, in the quiescent atmosphere itself, as a mere resistance, there are varying causes of fertility, which may be considered as having their maximum at the mean level of the sea, and diminishing in the proportion of the density, that is, as the squares of the heights above that level.

But it is by the action of heat that the cohesion of those substances which form the atmosphere is subdued, so that that fluid exists in the state of air; and therefore, the more rare or attenuated it is, the greater degree of action must be required for maintaining it in that state. But the heat which is necessary for maintaining the state of any substance is not *sensible*, not felt, or communicated to other substances; and therefore, the more rare or attenuated the atmosphere is, the greater must be its tendency to take the heat out of other substances. Consequently, as we ascend above the mean level of the sea, the atmosphere must become gradually colder, till at all places there be a point of elevation, higher than which the temperature shall never be warmer than that at which water freezes. This is called the point of perpetual congelation, or frost, and above it there can be no general action either of animal or of vegetable life. From partial data, it is not very difficult to calculate the average elevation of this point above the level of the sea for all latitudes; but when we come to practice, the calculations thus formed will not apply, because local circumstances have very considerable influence. Thus, on the mountains which rise out of the dry and warm table land of Mexico in America, the summer, or lower elevation of this point, is more than a quarter of a mile; and on the northern side of the Himalaya mountains, which have the extensive and dry table land of central Asia on the north, it is more than a whole mile higher than theory would lead us to suppose. Thus, though the law, that the atmosphere is colder as we ascend above the mean level, be a general law, which holds true in all parts of the world, yet the law is so much modified by other circumstances, that the precise determination of the decrease of temperature for any one place must always be matter of local observation. Here, however, we have another general effect of the diminished pressure and density of the atmosphere upon life and growth, which, though subject to local variations in amount, is uniform in principle; there is a diminished temperature as we ascend, and as temperature is one of the elements of living action, whether animal or vegetable, there must be a corresponding diminution of that action as we ascend above the mean level.

When, in addition to these, which may be considered as some of the effects of the atmosphere, considered merely as passive or neuter, upon the action of plants and animals, we add the operation of external causes, we find results of much greater importance. The heat of the sun is unquestionably one of the most powerful agents in the production of life and growth, and the grand medium through which that agent acts is the atmosphere. Clear notions of the mode of the action of heat through that medium are therefore absolutely necessary to anything like a rational understanding of the active parts of nature, and without that, natural history is a mere detail of dead specimens, unworthy the name of science, of small value in the arts, and affording neither occupation nor pleasure to a rational mind.

From the very nature of the atmosphere, or indeed of an organ of any kind, we might infer the general action of heat upon it, without any observation or experiment. The gaseous, or aërial state, is owing to the action of heat, which subdues the cohesion of the substance, and in proportion as it is rarefied, or has its cohesion farther subdued, the action of heat, which goes to the support of it in that state, and which is consequently rendered insensible, or incapable of being given out to other substances without a corresponding condensation of the air, must be increased.

Hence, generally, when air (atmospheric or any other) is heated, it expands, and when cooled it contracts or condenses; and if the expansion or contraction ever take place freely in the exact proportion of the action of heat, which is communicated in the one case or abstracted in the other, the air may pass through a considerable range of density without having its sensible heat altered. But, in consequence of the differences of pressure and density, air at different heights of the atmosphere can neither expand nor contract to the same extent with the same addition or abstraction of the action of heat. The pressure and density of the lower strata both tend to resist expansion, and the pressure at least tends to favour contraction; while, in the upper strata, the diminished pressure and the rarity tend to favour expansion, and the diminished pressure at least tends to hinder or diminish condensation. Wherefore, there is in the lower stratum of the atmosphere a tendency to give out to other substances any heat that may be communicated to that stratum, and this tendency diminishes as the height above the mean level of the sea increases. The effect of this must depend upon the degree of the action of heat which is communicated; but still, if we suppose that the whole of the atmosphere is equally exposed to any heating cause, the heat which is resisted by the atmosphere, and becomes sensible, and is given out to plants and animals, must be greatest at the level of the sea, and diminish as the height rises above that level. But, as heat is one of the most essential agents in the economy of all the living and growing productions of the earth, this tendency in that part of the atmosphere which is at the level of the sea to give out heat most readily, and the diminution of this tendency as the height increases, must again render the lowest places the most fertile, and productive of life of all kinds, and the more elevated ones less so, in the proportion of their elevation—that is, on the supposition that the soil and geographical position are the same, or similar.

But further: the grand heating cause to which the atmosphere is exposed is the rays of the sun, acting either directly, by refraction, by reflection, or by radiation; and in all these ways the solar light may be considered as acting upon the particles, or ultimate component parts of the atmosphere, although these parts are, individually, by far too small for being perceptible by our senses. This being the case, the action of the solar heat, or indeed of any other heat, come from whatever cause, and act in whatever manner it may, must be in proportion to the density of that portion of the atmosphere upon which it acts. Air twice as dense contains of course twice as many particles in the same space; and as these must all be equally acted upon by an equal heating cause, the heat communicated to one of double density must be double, and so on for other proportions. If the surface of the ground, or the objects upon that surface, have a lower temperature than that which the stratum of air next the ground receives from the heating cause, the heat will be, in great part, given out to them, and increase their temperature, and consequently their action in so far as that can be promoted by heat; but if the ground, or what is upon the ground, has a higher temperature, the effect of the heat communicated to the atmosphere will be to expand the portion next the ground, and cause it to ascend in consequence of the diminution of weight which the same volume of it sustains by the expansion.

Much, therefore, depends upon the kind of surface. If that be of a nature capable of receiving the heat which is imparted to the atmosphere, that heat will be communicated to it; and it will, according to circumstances, produce growth, or drying, or parching, and burning up. But if the surface is not in a condition to receive the action of heat, that action will be carried upward in the expanding air, and produce its effects in the atmosphere.

It was mentioned that, in the mountains which rise over the dry and warm table land of Mexico, the line of congelation is a quarter of a mile higher than the theory would lead us to suppose; and that on the *north* side of the Himalaya it is fully a mile higher. The latter would, to common observation, appear the more singular, not only on account of the greater difference, but because the Himalaya are in a more northern latitude than the Mexican mountains, and the situation where the line of congelation is highest is on their northern slope, or that which is turned away from the sun, while on the southern, or sunny slope, it is lower, though still considerably above what the theory from partial data would give. Now the plain of Mexico, though warm and dry, and of a character to have its temperature raised, by the direct action of the sun, so high as to receive no heat from the air, is yet not a barren plain, but in many places under natural plants of considerable growth, and in others under culture. Mexico is also at no very great distance either from the eastern or the western sea, and it is, in consequence, subject to occasional rains. The country to the north of the Himalaya is not so well known; but there is reason to believe that considerable portions of it are barren desert, and, parts of it, at least, are very rarely visited by rain. Accordingly, the country to the northward of the Himalaya, though probably more elevated than the plains of Mexico, high as that is, and having certainly an increase of latitude which with surfaces similar and similarly surrounded, would make it the colder country of the two, has yet its surface so much more susceptible to the direct action of the sun, that the heat which it resists receiving from the atmosphere, and that which it gives out to that fluid, together suffice to raise the line of congelation in the neighbouring mountains three quarters of a mile higher than in Mexico.

These two cases are worthy of being borne in mind, not only as they are in themselves singular and striking, but as showing to what an extent the action of the atmosphere, in the general economy of nature, may be modified by differences in the surface of the earth. This is the more necessary, because the actions of all the different surfaces that are met with on the earth, being matter of very ample and minute detail, some of which are yet but imperfectly known, cannot be developed in a general article.

Still the subject is one, without a notion of the general principles of which no man can either merit the name or enjoy the pleasure of being a naturalist, because it is the one which is pre-eminently concerned in "putting the wheels of life in motion," and causing them to work differently in different places, so as to produce that rich variety of contrasts which forms the grand bond of union and incentive to intercourse between nation and nation, and makes the inhabitants of different zones or hemispheres act as whetstones in polishing and sharpening each other.

The general law is, that the heat communicated to the atmosphere acts most upon those surfaces where its action is the most beneficial; and, where its action cannot be beneficially exerted, it mounts up into the higher strata, and is wafted to, and confers its genial influence upon, other regions. Thus the heat which cannot find fit employment on the thirsty heights of Central Asia, speeds southward to the slopes of the Himalaya; and in consequence the rustics tend their flocks, reap their simple harvests, and live in comparative plenty, where, according to the theory, the surface *should* be shrouded under fathoms of perpetual snow.

This, it must be admitted, is saying very little; and yet, in a general way, it is almost all that can be said, only it may be said in different words. Generally then, the heat communicated to the atmosphere by the sun acts more powerfully on humid surfaces than on dry ones. Not that it heats them more, but the reverse, for the heat is rendered not so sensible on the humid surface, in consequence of the increased action which it performs there. Dry surfaces which are pale in their colour return heat by reflection, and do not get so speedily heated as those of a darker tint, which after they are heated give out heat by radiation. Of humid surfaces, it is not the surface of pure water that most completely absorbs or occupies the action of heat. When still, the surface of pure water reflects back to the air much of the heat which falls upon it; and the more in proportion as it falls the more obliquely. Hence, sheltered places that have a clear lake or tranquil river on the south, or inclining to the south-west, are very warm, especially upon sunny days in winter; but places which are situated the reverse way to the river or the lake are proportionally cold. The contrast of such places, even when at no great distance from each other, is often very striking. Strand-on-the-green and Mortlake, both on the Thames, and not above a mile apart afford an instance. On a clear winter day, with the wind a little sharp at north, the contrast between the river side at Strand and that at Mortlake is almost as great as that between Dorset and Caithness. These are local actions, however, and have little or no effect beyond their limited locality.

When the surface of water is in a state of agitation, it retains much less of the heat which falls on it than when it is tranquil; and water which is shallow, and partially covered with reeds or other tall aquatic plants, returns less heat to the atmosphere than perhaps any other description of surface. All surfaces indeed which are covered with luxuriant vegetation, in a state of vigorous growth, consume much of the heat that falls on them, though there is no doubt that some portion of heat is set free, or become sensible in the process of growth, because in that process there is an expansion of the substance of the plant acting against the resistance of the air, and there is also the change of substances from a more fluid to a more solid state.

The general cause of the absorption of heat, or the apparent cold of humid surfaces, whether of the water, the moist earth, or of growing vegetables, is understood to be *evaporation*, or the conversion of water into invisible vapour, which rises and spreads in the atmosphere. This vapour may be considered as consisting of pure water, whether it is raised from pure water, water impregnated with other substances, the humid surfaces of growing vegetables, or any other source. At all events, if there are other substances accompanying it at the first, they are not raised to any great height, or carried to any great distance. Fogs and drizzling rains from the sea, especially if they come from low sandy beaches where the water is apt to get heated, sometimes tinge the hedges and trees with salt to the distance of a mile or two inland, but they do not reach far; and though the miasmata of marshes are said to produce ague, fever, and other diseases, in those who dwell in their immediate vicinity, the rains which result from vapour raised out of them are perfectly pure and limpid. It seems, therefore, that water is purified as well as raised and distributed invisibly through the air, in the process of evaporation.

This process of evaporation is perhaps the most important, in a natural history point of view, of all those in which the atmosphere is an agent, because it is the one in which the grand circulation of water originates, and without water there could be no life or growth upon land.

The process of evaporation is as general and common as it is important, and yet it belongs to that class of natural actions of which no very satisfactory account can be given. Its importance in a natural history point of view is so great that we shall hazard a few remarks expressly upon it in an article EVAPORATION; but we may remark in the meantime that there are two theories, each of which has some plausible arguments in its favour, and both of which are liable to objections of so much cogency as to render the truth of both very questionable. One of these theories is that evaporation is produced solely by the action of heat upon the water, and that the air has no concern in it, the vapour being buoyed up by its own elasticity. In proof of the theory, there is adduced the well-known fact that evaporation takes place very copiously in a receiver exhausted of air, in which case the air can have nothing to do in its production; and also another fact that a number of gases, of very different natures, are capable of holding exactly the same quantity of water in vapour. In opposition to the first and apparently most conclusive of these proofs, it is stated, that vapour is produced in the exhausted receiver, only because the pressure of the air on the surface of the water is taken off at the same time the air itself is removed; but that when the air is removed, and a pressure equal to its weight continued, which would be exactly the state of things in nature if the air had no agency in evaporation, the evaporation does not go on. In attempting to turn the edge of this objection, Dalton, notwithstanding all his abilities, failed. There are other objections, more in the way of common observation: evaporation is not always rapid in proportion to the heat, for on some intensely cold days, when there is a strong wind, it goes on with great activity; and those east winds which, in the early part of the season, not only dry the surface of the earth, but parch and wither the vegetation, are cold. Still, it is true that evaporation always produces cold; and therefore, though the action of heat is not the sole cause of it, it is certainly one of the causes, or one of the elements of the compound cause.

The other and more popular theory of evaporation attributes it to the chemical solution of water in the air, by means of an attraction or affinity existing between the two fluids; and though it has been urged against this theory that evaporation does not go on most rapidly when the air is densest, which, according to the theory, it ought to do, yet the effect of pressure in preventing, in the exhausted receiver, that evaporation which goes on freely and readily when there is no pressure, shows that, beyond a certain point of density, the ascertaining of which is of course matter of experiment, the pressure of the air checks and diminishes the process.

That some kind of attraction subsisting between air and water is, like heat, though not the sole cause of evaporation, yet, like that, one of the causes, or one of the elements of the compound cause, seems unquestionable. But it is doubtful whether this attraction should be called a *chemical* attraction, or the diffusion of vapour through the air a *chemical* solution. It is true that, in the formation of vapour, there is cold produced, or a certain degree of the action of heat is absorbed, and absorbed, no doubt, in the formation of the vapour; it is also true, that when the vapour is again condensed and falls in rain, there appears to be heat produced, or a certain degree of the action of heat which was previously imperceptible or *latent*, is rendered sensible; and it is also true that similar changes, with regard to heat, take place in many chemical solutions and their reversals. But a chemical solution of one substance in another, or which is the very same, a chemical combination, is never formed without some effort: the two substances so united to a certain extent become one, that one has new properties which did not belong to any of the two singly, and the combination cannot be dissolved without some action.

It would be contrary to the observed facts, as well as to the analogy of nature (the only guide which we have where our mechanics and chemistry fail us), to suppose that the water which the atmosphere holds in the state of vapour, is combined with the atmosphere by any chemical process. One chemical attraction cannot be overcome but by another and more powerful attraction of the same kind, and no chemical compound can be dissolved without more powerful chemical action than that by which it was formed and is held together. But we find the atmosphere parting with its humidity to the smallest animal, or the most tender leaf, with no more effort than when it parts with its oxygen in the process of respiration. Analogy, indeed, points out to us, with a force of reason not easily to be resisted, that no other substance can combine more intimately with the atmosphere, than its two grand component elements, oxygen and nitrogen, combine with each other; and it has been shown, in the article Air, that these can always be separated without any thing approaching to the nature of a chemical process. The atmosphere is the grand messenger of nature, and whatever is carried free to all the productions of nature, without labour or exertion on their part. Chemical compounds are never formed in nature, unless the compound body has some functions to perform as a whole. Such at least is the case with all compounds formed according to our chemistry. But our chemistry, extensive and important as it is as a science, and valuable as its applications are in the arts, is a very partial, and therefore doubtful and deceptive agent, when we bring it to the philosophy of nature. It applies to dead matter only, and therefore when we attempt to use it either in the explanation of any one function of life, or of that upon which life depends, it fails, or leads us into error. Now the atmosphere is preeminently the element of life; and therefore we can hope for little aid from chemistry in our investigation of the natural properties and agencies of the atmosphere.

That there does exist some sort of attraction between the atmosphere and the water which it takes up in the process of evaporation, cannot be doubted; as little can it be doubted, from the short distance to which foreign substances accompany the union, that this attraction is for water in its pure and simple state,—for water, not as it holds only one or two substances in solution, and is fit only for the particular operations in which those substances are agents, but in its simple state, equally fit for all purposes to which water can be applied. Of what particular nature this attraction is, we are ignorant, and it belongs to that class of natural actions, respecting which we have little chance of gaining any information, further than observing the results. Perhaps we shall not err very much, if, to distinguish it from every thing chemical, and from all those attractions in which the action of heat, under any of its modifications, is the agent, we call it a *corpuscular* attraction,—an attraction belonging to the same class with that by which one liquid mixes with another without change of temperature or action of any kind; that by which fluids wet the surfaces of solids, and many others which are not chemical, neither are they mechanical, as they do not depend upon gravitation. It appears, from the fact that there is always air between substances which prevents them sticking together, unless in the case of what appears to be a stronger corpuscular attraction of the substances, that the air has a corpuscular attraction for every known substance; and that all substances whatever might rise in vapour in the atmosphere, provided their cohesion were sufficiently overcome by the action of heat, or by any other means. This property, which is verified by the facts as far as these go, points at a most extensive, almost a universal use of the atmosphere in the operations of nature. This view of the atmosphere opens a very wide field, and one in which the judicious inquirer has still much wisdom to win; but it is one upon which we cannot in the meantime enter. Our more immediate business is with the atmosphere as the recipient of the vapour of water, and the distributer of that water to the general surface of the earth in rain, or to particular substances for silent absorption.

This is the simple and general view of the matter which is most essential to the proper understanding of natural history; and it is of the utmost consequence that our views of it should be clear and accurate, because it is a subject which, if we study nature at all in its connexion, we are constantly meeting. We are, then, to understand that the air takes up, from all humid surfaces, moisture in the state of invisible vapour; that this is taken up by the corpuscular attraction of air and water, and the action of heat, jointly, though the heat may act sometimes as electricity as well as generally as ordinary heat; that the moisture so taken up is distributed through the air, and sustained there by the same agencies which raise it in vapour; but that, though dispersed and invisible, it is not combined, but always ready to be given out without chemical effort.

The heat which the atmosphere receives, whether from the direct rays of the sun, from reflection, or radiation from the earth, or any other cause, in like manner enters into no chemical combination with that fluid, so as to produce what may be its final action there, If the surface of the earth is not of a nature to receive it, and profit by it, then it acts in expanding the atmosphere; and the part so expanded ascends, carrying with it the water which it may hold in a state of vapour. The action of heat, therefore, puts the atmosphere in motion, and enables it to waft from place to place the water which it holds as vapour.

The capacity of retaining water in the state of vapour increases with the increase of heat, and diminishes with its decrease, but the two do not vary at the same rate. In theory, the power of retaining moisture should increase and decrease faster than the heat, because it is promoted by two causes, the action of the heat, and the diminished density or pressure of the expanded air. In practice, the facts agree with this theory; and if they did not, it is not easy to see how the atmosphere could part with the moisture which it has once held as vapour. Those east winds which frequently injure vegetation on the low-lying grounds upon the east side of England, often arrive on the coast in a state of complete saturation, and ready to deposit their humidity in rain; and, where bleak and elevated districts abut upon the shore, they produce rain. But the low and warm grounds, in Essex, Suffolk, and Norfolk, for instance, radiate, or otherwise give out as much heat as converts what upon the bleak and elevated land would be a moist and raining wind into a drying one; and this will go on for weeks, till the fields are as dry as a summer path, and the vegetation is perished and shrivelled; nor is there in the places which those east winds scourge any means by which to stop their progress, or even mitigate their action. But when these winds reach the high grounds in the midland counties, where they have a colder surface, and also a greater elevation, they are no longer able to retain the whole of the humidity with which they are charged, but deposit part of it in rain. The evaporation of that rain cools the surface and the air over it; the east wind is, in consequence, checked in an earlier part of its course; the rain falls more easterly, and may conduct the east wind to the coast, while the south-west wind follows in the rear; or the opposition of the westerly wind may produce a similar result, in a manner to be afterwards explained.

The kinds of surface which the globe, at different places, presents to the sun, are various beyond any enumeration shorter than separate descriptions of the whole, and the action of the sun upon them is just as varied. This holds not only with regard to the land, but in some instances also with regard to the sea, the cold produced by evaporation from which, and the action of its currents, are not jointly able to maintain a uniformity of temperature, either in the water itself or in the atmosphere over it. Unlike the atmosphere, indeed, the sea has very little tendency to be thrown into currents by the different action of heat upon it several parts. The cause is evident: the expansion of water by heat and its contraction by cold are very limited; and the evaporation where the action of the sun is greatest, is not sufficient to produce a sensible motion even of the mere surface. Where the water is comparatively shallow and clear, and the bottom of a light colour, the heat of the perpendicular sun returned from the sea, is indeed not much less than that returned from the surface of dry land. This is severely felt by navigators in Torres' Strait, in a considerable portion of the sea on the north coast of New Holland, and in other places, where one can hardly bear to look down on the water, and the air over it has a temperature of from 110° to 120° of the common thermometer. There, from the heat of the air and that of the water, the quantity of evaporation must be supposed to be very great; but the cold which it produces is not increased in the same proportion. In the polar seas, on the other hand, the effect of evaporation adds so much to the natural cold of the air, that while by the action of the direct and reflected rays of the sun, the pitch on the sunny side of a ship melts and runs down like water, the frost under the shade is more intense than when the sun is obscured. We have approximations to that in some of the colder parts of Britain, where, though the direct sun feels warm, the cold in the shade is more intense than on a cloudy day.

The heat from reflected light over the sea, if none is returned from the bottom, is least where the sun is perpendicular, and increases as the direction becomes more oblique. It is also greatest when the surface is smooth and glassy, and the cold produced by evaporation is then also the least, so that a curl upon the water is always a means of cold. When the water is deep, the heat never has so much influence upon it, so that, even under the vertical sun, there is a cooling effect in the sea.

The surfaces of the land are much more varied, and all that can be said of them is, that with an equal action of the sun, or of any other heating cause, the surface which is the most humid, and parts with its humidity with the least action, is always the coolest.

The leaves of plants which are growing vigorously and cover the ground with their shade, and which have at the same time an abundant supply of water at the roots, present, perhaps, the most cooling of all surfaces. They not only multiply the actual surface upon which they grow many times over, but they aid the evaporation by the tendency they have to give out moisture. Whether they give out moisture by the same pores, or other parts of their surface, by means of which they at other times absorb it, is, though probable, not proved, and perhaps not capable of proof; but it is certain, that when they have an abundant supply, they absorb more than is necessary for the ultimate purposes of vegetation. This, in particular situations, and at particular seasons, they give out in greater quantity than the evaporative power of the atmosphere can receive; and thus they are found humid and dripping, in cases where there can be little or no condensation of atmospheric moisture upon them. Besides giving out to the atmosphere a portion of that moisture which they receive from the soil by their roots, they, under other circumstances, appear to give out to the soil by their roots a portion of that which they receive from the atmosphere by means of their other surfaces; and when the roots have penetrated into strata not capable of retaining any moisture, the plant may be parched while there is humidity in the air, just as by hot and dry air it may be parched while there is humidity in the soil. All these circumstances tend to show that plants excite a more powerful action in the atmosphere, or engage it in more powerful action than bare surfaces of any description, and that, therefore, surfaces thickly covered with them preserve a more uniform temperature amid atmospheric changes, whether diurnal or seasonal, than any other surfaces of the land.

These are but a very few out of a vast multitude of circumstances, but they may afford some assistance in forming a notion of the general principle; so that, bearing them in mind, and bearing in mind also that the atmosphere is always taking up moisture by evaporation, and that heating expands it and gives it a tendency to ascend, and cooling produces the opposite effects, we are in a condition for forming some notion of its general action in the economy of nature.

The sun is the grand agent which puts the whole in motion; and the peculiar motions of the earth so vary the sun's action with days and seasons, that the details of this part of the subject, even without reference to the variety of surfaces upon which the sun acts, render this single part of the subject extensive as well as complicated.

It may hardly be necessary to state, that the rotation of the earth from west to east causes the apparent revolution of the sun from east to west in twenty-four hours; and the path of the point where the sun is vertical shifts northward from our midwinter to our mid-summer, and southward the other half of the year. His daily change is smaller at the beginning and end of each half-year, and greater at the middle of each, which are the times of the equinoxes.

The point where the sun is vertical, or at least that point in the apparent path of the vertical sun where the heat is greatest, is the centre of the solar action; and in the course of each year it travels in the manner which has been stated. At that point the atmosphere has a tendency to expand and ascend, greatest at the surface, and greater in proportion as that surface is susceptible of being heated. The air from the adjacent places presses in to supply the room of that which is heated and ascends; and as the centre of heat is apparently in rapid motion westward, the motion of the air towards it is turned in that direction. The chief motion of the air is of course from the north and south, because the heating cause has passed over the parts to the east. but is approaching those to the west, and the westward motion causes that from the north to come as from the north-east, and that from the south as from the south-east. These do not meet by a considerable space, because, as they approach the centre of heat they begin to feel its influence and ascend. But if the globe had a surface uniformly susceptible to heat, they would play round it constantly, shifting northward and southward with the apparent place of the sun. The surfaces of the great oceans clear of the land are nearly uniform; and these currents play over them, and are well known as the trade-winds. Of course these winds, which are nowhere very violent, diminish as the distance of that which is their cause increases; so that they are not felt to any very great distance either northward or southward. They however produce, in the upper strata of the air, winds in the opposite directions, because the air cools as it ascends, and it is urged onward by the ascent of a fresh supply from the surface. As that returning portion recedes from the central cause of heat, it descends and gives out heat; and thus the atmosphere distributes the heat of the sun northward and southward.

The land interferes with the regular motion of these winds, by intercepting them by its elevation and also by affecting the heat of the air by its surface Thus the wind which is a surface-wind over the desert in northern Africa, is too rare for being a surface-wind over the Atlantic. Therefore it ascends instead of moving westwards; and a considerable portion of the sea is calm or without wind. But the air which was so much heated carries with it much more moisture than it can keep suspended in the more elevated part of the atmosphere to which it ascends; and the result is, that those tranquil portions of the sea are visited by frequent and heavy falls of rain—so much so, that they are popularly called "the rains." These calms and torrents of rain do not take place immediately upon the African shore, but so far out at sea as to allow the stagnant portion of the atmosphere to be compressed laterally by the currents from the north and south east.

On the western coast of America, at some distance from land, there are similar calms and rains; but as the portion of the American continent off which they are found is higher and not so dry as the northern part of Africa, they are neither so marked nor so constant in their appearance. In both oceans these calms and rains are to the north of the equator. There are two reasons for this · first, the parallel of maximum heat is a little north of the equator, as our summer half-year, being the one which occupies the *aphelion* portion of the earth's orbit, is longer in absolute time than the other; and secondly, the land immediately under the equator, and even for a considerable distance to the northward of it, is not favourable for their production. Guinea is a fertile country, with luxuriant vegetation near the shores, and rising into mountains in the interior; and Peru, the greater part of the narrow isthmus in America, and also Mexico till considerably northward, are mountainous.

The places which meet the current of the trade-wind, or receive it from the oceans, are, as may be supposed, the very reverse of those at which it commences. They are the oriental seas and the Malay peninsula on the west of the Pacific, and Brazil, the whole north coast of South America, the West India islands, and the narrow part of the isthmus on the west of the Atlantic. In both situations some places are land-locked, or covered seaward by others, so that the action of the current upon all is not alike: the general direction of the coast, too, throws the current over the Pacific southward, and that over the Atlantic northward. The last is very remarkable; and notwithstanding the intense cold of the north of America, there are traces of a tropical character, both in the plants and the animals, to some distance up the valley of the Mississippi. There is at least one species of palm; there are both land and water reptiles of tropical character; and there are marsupial animals as far to the north as Virginia.

All those places which receive the trade winds, or currents of the atmosphere, which have swept for long distances over the tropical seas, are remarkable for the richness, the variety, and the peculiarity of their productions, both vegetable and animal. The trees of the Oriental isles are equally remarkable for the richness of their foliage, the fragrance of their flowers, the flavour of their fruits, the aromatic pungency of their spices, and the beauty of their timber. They are the chosen habitations of the true-apes, of monkeys innumerable, of climbing birds of the richest plumage, and of that singular race, the birds of Paradise. There, also, the crushing serpents attain their largest size, and the poisonous ones their most deadly venom. Islands with broken surfaces, and romantic alternations of forest and rock, are not the proper haunts for the larger beasts of prey; but those of intermediate size in the Eastern isles are as peculiar as the other productions.

Nor is the exuberance of nature confined to the land; for in all places where the bottom can be seen, the sea is equally fertile and varied in plants and in animals. The mollusca, the crustacea, the annelidæ, and even the common finny tribes of the deep, are abundant, curious, and glowing in their tints, in those places of the intensity of nature's action. Colour of the utmost brilliance, both in plants and in animals, is one of the characteristics of those all-prolific climes; and that colour not only beautifies all upon land, but plunges down into the waters and elicits radiant tints there. Where the solar rays come nearly perpendicular, they act upon the earth and enter the waters nearly in equal parts of the whole spectrum, whereas, when the rays come sloping, the blue and violet, and those tintless rays beyond, which appear to have, with *iodine*, and with the production of both pungency and colour, some mysterious connexion which the present extent of science is unable to explain, are dissipated by refraction; and hence, as we approach the poles, colours, properly so called, become few and faint, and, both in plant and in animal, they tend gradually to the ultimate contrast of black, the absence of light, with white, the presence of light unbroken by action. But, in the regions under consideration, we have every glory which the bow of heaven can display, heightened and varied by all the assistance of deep velvety surface, metallic lustre, and the playful iridescence of changing hues.

In the west, the corresponding lands are different, but they are hardly less striking. We have the rosewoods, the mahogany, the dyewoods, the allspice, and countless species of medicinal trees; we have the sloths in place of the apes, and monkeys as abundant in number though different in form; we have also macaws and humming-birds, and toucans, and many other winged creatures, gay in their colours and curious in their shapes and habits almost beyond description; nor must we forget the fang of the bushmaster, the most formidable perhaps with which any reptile is armed. It is to be borne in mind, too, that here the influence extends over a far wider range. The isles of the east are only, as it were, a few gardens, while America is a wide field; and the influence of the current sweeps round from Cape St. Roque to the Mississippi, and plays along the mighty valley of the Amazon, as far as the base of the Andes.

There is one curious point, though philosophy has not yet brought it into any connexion. The terminations of these two currents are *antipodal*, or at the opposite ends of a diameter of the globe, a coincidence which happens with very few places, as almost all the rest of the land has its antipodes in the sea. They are also both volcanic, and the centres of the great volcanic actions in the east and the west. In the present state of our knowledge, it is impossible to say that the atmospheric currents have any connexion with the last-mentioned circumstances; but the fact is worth bearing in mind, and *may* lead to some important result. The atmosphere is the grand messenger of the whole globe, bearing heat and moisture, regulating the action of these, and therefore highly influential in all that the different regions present or produce. But the philosophy of it is as yet in mere embryo; and the facts to be observed are so many, and the generalisation of them requires so much care and judgment, that the man who shall stand upon the basis of inductive truth, and tell the world all the wonders of its working, is not yet born.

We should now proceed to show how the same properties of the atmosphere work on the local and the minute: how the lake and the dry common, the stream and the meadow, the copse and the field, and even the field which is under crop and that which is bare, work together; but the subject has already beguiled us to the full extent that we can spare; wherefore we must refer for some of the details to the general remarks introductory to the accounts of those vertebrated animals, which are characteristic of peculiar localities, and close this desultory article by recommending every one who wishes to know nature on the grand scale, carefully to study the atmosphere.

ATOMARIA (Marsham). A minute genus of coleopterous insects, belonging to the family *Xylophaga* of Latreille, *Engidæ* of MacLeay, or *Corticaridæ* of Curtis. In this genus are included some of the most minute species of beetles, scarcely any of them exceeding the twenty-fourth part of an inch in length; and yet in these atom forms, which would be almost destroyed by the fall of a pin's head, we find the same beautiful organisation, the same number of parts and joints, and are consequently warranted in supposing a perfectly similar disposition in the internal organisation which is found in the giant stag beetles, or the still more gigantic hercules or elephant beetles. It has been much the fashion to regard every thing coming from the French as at least tinctured with infidelity; we have, therefore, the greater pleasure in quoting the words of that distinguished French entomologist, who had fairly won for himself the title of "Entomologorum princeps"—the late Latreille:—

"The wisdom of the Creator never appears with more effect than in the structure of those minute beings which seem to conceal themselves from observation, and Almighty power is never more strikingly exhibited than in the concentration of organs in such an atom. In giving life to such an atom, and constructing in dimensions so minute so many organs susceptible of different sensations, my admiration of the Supreme Intelligence is much more heightened than by the contemplation of the structure of the most gigantic animals."

These insects have the antennæ clubbed, and as long as the thorax, with the second joint longer than the third; the elytra convex and entire; the thorax with entire margins; and the body ovate-linear. There are more than twenty British species, of which the *Silpha evanescens* (a most appropriate name) of Marsham may be considered as the type. They reside in damp and obscure situations, but are fond of flying in the hot sunshine.

ATOPA (Paykul, Stephens; Dascillus, Latreille, Curtis). A genus of coleopterous insects, belonging to the section *Malacodermata*, or soft-cased beetles of Latreille, and referred to the family *Cebrionidæ* by Latreille and Stephens, and to the *Telephoridæ* by Curtis. The body is elongate and convex; the antennæ are long and filiform; and the lower jaws and lip are furnished with several slender pencilled lobes. There is only one British species, the *Chrysomela cervina* of Linnæus, which is very local, preferring chalky districts, and found upon alders and brambles: it is of a buff or dark brown colour, and not quite half an inch long.

ATRACTOCERUS (Palisot de Bauvais). A very extraordinary genus of exotic coleopterous insects, belonging to the division *Pentamera* and family *Lymexylonidæ*. The body is very long, narrow, and depressed, and the elytra are so minute that a late German author speaks of one of these insects as "Animal valde singulare et memorabile; prope tu credideris naturam quasi hæsisse an coleopteron an dipteron crearet."—From the singular formation of this animal, you might almost fancy that nature was in doubt whether she should create a beetle or a fly. The antennæ are short and fusiform, and the wings extend nearly to the extremity of the body: the palpi of the males are furnished with a remarkable branched appendage. There are three or four species, inhabitants of South America and Africa: they are found amongst woods, probably residing under the bark of trees.

ATRAGENE (Linnæus). An ornamental genus of climbing shrubs, natives of Europe. Linnæan class and order, *Polyandria Polygynia;* natural order, *Ranunculaceæ*. Generic character: calyx of four sepals, deciduous; corolla ten or twelve, linear; stamens inserted on the receptacle, filaments very short; anthers oblong, pointed; style, hairy, with persisting stigmas; caryopses many, with tail-like styles. This genus is nearly allied to virgin's-bower; and when trained to a trellis or wall having a northern aspect, are elegant plants.

ATROPA (Linnæus). A genus of two species, one a British herb, the other a West India shrub. Linnæan class and order, *Pentandria Monogynia;* natural order, *Solaneæ*. Generic character: calyx five-parted; corolla funnel or bell-shaped, limb five, occasionally ten-lobed; stamens somewhat protruded; berry two-celled; placenta loose. The *Atropa belladonna* is one of the most dangerous vegetable productions of Britain. The berries resemble cherries, and are liable to be mistaken for wholesome fruit; but eating them is death, as has often happened to children. This plant grows in waste corners of fields, or under the shade of ruined buildings or old trees. It should be rooted out wherever found.

ATROPOS (Leach). A genus of Neuropterous insects, belonging to the family *Psocidæ*, and separated from *Psocus* by Dr. Leach, from the circumstance of the tarsi being three-jointed, and the wings wanting. The type of the genus is the *Termes pulsatorium* of Linnæus, a minute insect, commonly met with amongst old books, and upon the paper on walls. It is of a dirty white colour, with the eyes and a row of spots long the abdomen reddish. Its specific name alludes to the noise which it makes, similar to the ticking of a watch, and which has often been confounded with the ticking of the death-watch.

Atropus pulsatorium.

ATTA (Fabricius). A genus of hymenopterous insects, belonging to the family of the ants, *Formicidæ*, differing from *Myrmica* by their very minute palpi, and by the large size of the heads of the neuters. In this genus is included some of the largest species of ants, some of them exceeding an inch in the length of the body. The *Formica cephalotes* of Linnæus and Fabricius is the type of this genus: it inhabits various parts of South America, where from its habits it has received the name of the visiting ant, "la fourmi de visite," since it occasionally finds its way in troops into the houses of the residents, who open their doors and receive it gladly, as it consumes or drives away not only the cockroaches and spiders, but even mice and rats.

Atta cephalotes—neuter (magnified).

ATTACUS (Germar). Saturnia (Schrank). A genus of nocturnal lepidopterous insects, separated from the great Linnæan genus *Phalæna*, of which it formed a section, and comprising some of the largest and most beautiful moths; the wings when the insects are at rest are extended and horizontal, and often adorned with a transparent patch in the centre; amongst these, the atlas moth of China is one of the finest species. The cocoons of some of these species are employed in the East Indies for the manufacture of silk, namely the *Bombyx mylitta* of Fabricius, and the *Phalæna Cynthia* of Drury (see the seventh volume of the Linnæan Transactions, also a paper by Colonel Sykes, recently read before the Royal Asiatic Society); the emperor moth, *Phalæna attacus pavonia minor* of Linnæus, is the only British species belonging to this genus, and which is placed by recent entomologists in *Saturnia* as a distinct sub-genus. The *Tau* emperor, *Phalæna attacus tau* of Linnæus, forming the sub-genus *Aglia* of Ochsenheimer, is reputed to be British.

ATTAGENUS (Latreille.) A genus of coleopterous insects belonging to the division *Pentamera* and family *Dermestidæ;* the type of the genus being the *Dermestes pellio* of Linnæus, a small British insect about one-sixth of an inch long, of a black colour and oblong form, with a white spot in the centre of each wing-case ; the antennæ have the last joint long, especially in the males, in which it equals the entire length of the remainder of these organs. The maxillary palpi are filiform, the second and fourth joints being the longest. These insects are sufficiently common in old houses, larders, &c., attacking the skins of preserved animals, old books, paper and wood. The larvæ is particularly destructive to neglected zoological collections. It is furnished with brushes of hair, which it possesses the power of expanding, thus resembling the *Anthreni*, to which it is otherwise nearly allied.

ATTALIA (Humboldt). A genus containing seven species of Brazilian palms. Linnæan class and order, *Monœcia Monadelphia;* natural order, *Palmæ*. Generic character: flowers male and female separate, sitting, on one side; spadix branched, rising from the root; spatha one-leaved; calyx of three small sepals; corolla of three fleshy petals; stamens inserted on the base of the pistils; styles three; drupe fibrous, three-celled, each one seeded, shell woody, furrowed, three holes at the base, kernel solid. These palms are described as most magnificent in form and height.

ATTELABIDES (Schoenherr.) A sub-family of insects belonging to the *Coleoptera tetramera* and family *Curculionidæ*, having for its type the genus *Attelabus* of Linnæus. This genus, it is to be observed, was one of the most heterogeneous of all the Linnæan groups, being a receptacle for all beetles with the head narrowed behind into a neck, and antennæ thickened. As now restricted, and raised to the rank of a sub-family, it comprises those species of weevils which have their antennæ not elbowed in the middle, the head narrowed and lengthened behind the eyes, and the elytra oblong-ovate. The chief genera included in it are *Apoderus, Attelabus* and *Rhynchitis.* The genus *Apoderus* (Olivier) is a pretty group of *coleopterous* insects, having the rostrum short and thick, and the head lengthened behind the eyes into a long neck. In some of the exotic species, especially those brought from Nepaul by General Hardwicke, this neck is nearly half the length of the body. The only ascertained British species, is the *Attelabus avellanæ* of Linnæus,

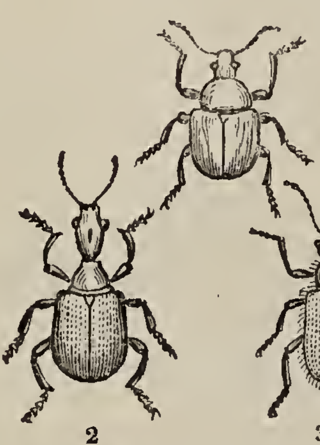


Fig. 1, Attelabus curculionides. Fig. 2, Apoderus avellanæ. Fig. 3, Rhynchites cavifrons.

which is red with a black head; it is about a quarter of an inch long, and is found upon the hazel and oak abundantly. The genus *Attelabus* comprises only one British species, the *A. curculionidæ* of Linnæus. It is distinguished from *Apoderus* by its antennæ being eleven instead of twelve jointed, and by its head not inserted into the thorax by means of a distinct neck. It is of a black colour, with the thorax and elytra bright-red; is about one-sixth or one-fourth of an inch long, and is very common on the nut and oak. The genus *Rhynchites* of Herbst, comprises some of the most beautiful species of weevils found in this country. Amongst these the *Curculio auratus* of Scopoli (hitherto confounded by all British entomologists with the *Curculio Bacchus* of Linnæus) is the most splendid as well as the rarest. The genus is distinguished by its dilated rostrum, eleven jointed antennæ, and head not produced into a neck. There are nearly twenty British species. Schoenherr enumerates forty-seven species. They are found upon various vegetables and trees. Our figure 3 represents the *Rhynchites cavifrons* of Chevrolat (Schon. Curcul. i. p. 226.), a species allied to *Rh. pubescens*, which we here introduce for the first time as a native species.

ATYPIDÆ. A family of *Arachnida Demerosomata* or spiders, having four pulmonary sacs, and four spiracles; the palpi are inserted upon a lateral and basal dilatation of the maxillæ, and are five-jointed, the last joint being long, and pointed at the tip in both sexes : the males have no strong spur at the extremity of the anterior shanks. This family comprises two genera only, *Atypus* (Latreille, *Oletera* Walckenaer), and *Eriodon* (Latreille, *Missulena* Walckenaer). In the former the jaws are very large, the eyes on each side of the head are united together, whilst in the latter they are placed widely apart. The *Atypus sulzeri* has been taken by Dr. Leach, near Exeter and London. It burrows in shelving turfy ground, forming a cylindric cell about seven or eight inches deep, at the bottom of which it spins a lining of white silk, and to which the eggs, enclosed in a similar silken case, are attached. The *Eriodon occatorius* is an inhabitant of New Holland.

Atypus sulzeri.

AUCUBA (Linnæus). A Japanese shrub of great beauty. Linnæan class and order, *Monœcia Tetrandria;* natural order, *Rhamneæ*. Generic character: flowers monœcious; calyx truncated, persisting, imperfectly four-toothed; corolla of four oval spreading petals; disk, round the germen (in the male flowers encircling the base of the style), flat, the middle marked with a hole; stamens inserted in the receptacle, alternately with the petals; filaments thick, very short; anthers oval, double, with four furrows; style short, persisting; stigma headed; berry many-seeded. This fine shrub was introduced from Japan in 1783, and was treated first as a stove, and afterwards as a conservatory plant, for many years. It has now become one of our hardiest and commonest shrubs in gardens, and withstands the rigour of our winters, even better than the common laurel. The flowers are inconspicuous; but its yellow spotted leaves make up for this deficiency, and have gained for it the name of "golden laurel."

AUCHENIA (Marsham). A genus of coleopterous insects, belonging to the division *Tetramera*, and family *Galerucidæ*. It has been much restricted by recent authors; and Mr. Stephens places in it only one species, the *Chrysomela*, 4-*maculata*, a pretty insect, which we have met with in marshy places near London. It is of an ochreous colour, with four black spots on the elytra, and is distinguished from the *Adimoniæ*, with which Mr. Curtis unites it, by the antennæ, having the third joint twice as long as the second; whereas in the *Adimoniæ* they are nearly equal. In the latter genus are comprised two beautiful British species, the *Chrysomela Alni* of Linnæus, which is very rare, and the *Chrysomela halensis*, a very common species on various plants: it is about a quarter of an inch long, of a golden green colour, with the thorax yellow, and the legs brown.

AUGITE. A mineral which derives its name from a Greek word, indicative of its lustrous character. There are four distinct species of augite, viz. the oblique-edged, the straight-edged, the prismatoidal, and the prismatic augite.

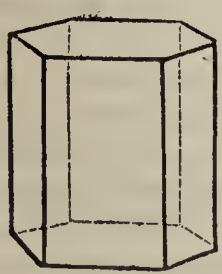


Fig. 1.


Fig. 2.

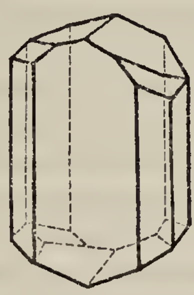


Fig. 3.

The foliated augite, which occupies a prominent place in the first species, is of a dark green colour. The form of its primary crystal is a four-sided prism. One of its secondary crystals is shown at fig. 1, consisting of a six-sided prism. Another form is exhibited at fig. 2, in which it assumes the character of an eight-sided prism, bevelled on the extremities. Fig. 3 is also an eight-sided prism, in which the obtuse terminal edges of two opposite planes meeting under acute angles are truncated. This form of augite occurs in secondary trap-rocks, and in lava as well as in basalts. This mineral is principally distinguished by its strong internal lustre, and peculiarly marked crystallisation.

As augite is sometimes mistaken for basaltic hornblende, it may be advisable to state their respective characteristic distinctions. Augite is, as we have already stated, of a greenish black colour, while basaltic hornblende is invariably of a much deeper black; it is also softer than augite. Another very peculiar characteristic of hornblende is that it can readily be fused by the agency of the blow-pipe: augite, on the contrary, is very difficultly fusible.

The varieties of this mineral, which are very numerous, and possess great interest in a scientific point of view, will be fully described in their alphabetical order.

AULOPUS—"pipe-fin," in allusion to the large external rays of the abdominals. A genus of soft-finned fishes, with abdominal fins, belonging to the salmon family, and combining in rather a singular manner some of the characters of the salmon and some of those of the cod. There is but one known species, the *Salmo filamentosus* of Bloch, so called from the filaments or beard resembling those of the cod. The gape is wide, and extends far backwards. The intermaxillary bones, the palate, the edge of the vomer, and the lower jaw, are furnished with one even row of recurved teeth; but the tongue is smooth, and the flat part of the palate is without any. The maxillary bones are large, but without any teeth. The abdominal fins are placed immediately under the pectorals, having their external rays very large, so that they seem forked. The first dorsal fin occupies a portion of the back, answering to the anterior half of the distance between the abdominal fin and the anal. They have twelve rays in the gill-flaps. Their bodies, cheeks, and gill-lids are covered with large scales, something similar to those of the salmon. In the spawning time they frequent the banks and shallows, but it does not appear that they ascend the rivers.

AULOSTOMA—"pipe-mouth." A genus of spinous-finned fishes belonging to Cuvier's fifteenth and last natural family of the order *Bouches en flute*, which of course has the same meaning as the name of this genus. The fishes of this curiously formed family, which are known to English sailors by the common name of "pipe-fish," without regard to the generic distinctions, form only four genera, and the species are not numerous. They are all natives of the warmer seas, but one species at least is found in the Mediterranean. The distinguishing character of the family is the mouth lengthened into a sort of tube or pipe. There are two divisions,—*Fistularia*, in which the body is long and slender; and *Centriscus*, in which it is oval and compressed. Aulostoma belongs to the first division; but neither the tube nor the body is so long in proportion, as in the other genus of that division, *Fistularia*.

Aulostoma has several free spines in front of the dorsal; the body very scaly but slender, though it is enlarged and compressed in the portion between the dorsal and the anal fins. This enlarged portion is followed by a short and slender tail, which terminates in a caudal fin of the ordinary shape. The air-vessel is uncommonly large for the size of the fish. There is but one species, a native of the Indian seas.

AURANTIACEÆ—the orange tribe. A natural order of plants, the thirty-seventh of the Jussieuan system, containing about a dozen genera, and between thirty and forty species. The name *Hesperideæ* is also applied to this order. The essential botanical characters of the family are,—calyx pitcher or bell-shaped, short, from three to five-toothed, withering; petals varying in number from three to five, broad at the base, sometimes distinct, sometimes united; stamens equal in number with the petals, double or triple; filaments compressed below; ovary many-celled, ovate; one rounded style; fruit many-celled, the cells filled with pulp, enclosed in little bags, and surrounded by a thick rind, which abounds in glands containing volatile oil. The plants belonging to this order are beautiful evergreen trees or shrubs almost exclusively natives of the East Indies, whence they have been introduced into different parts of the world. Their thick leaves articulated with the petiole, and furnished with pellucid dots containing an essential odoriferous oil, are their obvious peculiarities. Their flowers are generally white and fragrant, their wood hard and remarkably compact, and they produce a fleshy edible fruit containing an acid pulp. Many of them are prized both on account of their medicinal qualities and the esculent fruits which they yield. In general, their properties are aromatic, stimulating, and refrigerant.

The orange, lemon, lime, and citron, may be mentioned as examples of this order. Of the *Citrus aurantium*, or orange, there are several varieties, the chief of which are the sweet or China orange, and the bitter or Seville orange. The latter is the variety used in medicine, and ordered in the pharmacopœias. The orange originally came from Asia, but is now cultivated in Italy, Spain, Portugal, and the warm regions of Europe, as well as in the West Indies. It requires a mean annual temperature of 62°. It produces fruit in great abundance. A single orange-tree at St. Michael's has been known to produce 20,000 perfect oranges fit for packing. On the same tree we meet with flowers, unripe and ripe fruit. The juice of the orange has an acid taste, and consists of citric acid, mucilage, and syrup. It is used as a refrigerant in fever and inflammatory complaints, and as a cure for scurvy. The outer rind of the fruit is aromatic and bitter, and contains much essential volatile oil. It is used as a tonic to strengthen the stomach and promote digestion. The oil was formerly employed in epilepsy and convulsive diseases. The rind of the bitter orange is prepared by confectioners in various ways. When boiled with sugar and dried, it is sold under the name of candied orange peel, and when made into a sort of jelly, it forms the well-known preserve called marmalade. The unripe fruit when dried receives the name of Curaçoa oranges, and is used in the manufacture of the rich liquor known by that name. The flowers of the orange are of a beautiful white colour, and diffuse a most fragrant odour. They are used as a perfume and condiment. Orange-flower water is given in large doses to procure sleep. A fragrant red-coloured oil is distilled in Italy from the flowers, and is called *oleum* or *essentia neroli.*

AURANTIACEÆ. Citrus aurantium. *a*, Flower; *b*, stamens, to show the union of the base of the filaments *c*, pistil and germ; *d*, transverse section of the ovary, *e*, ditto of the fruit; *f*, seed.

The *Citrus limonum*, lemon-tree, is also originally from Asia, but is now widely distributed over different parts of the globe. The fruit of this tree is more acid than the orange. The juice is used as a refrigerant and antiseptic in febrile diseases and in scurvy; and along with carbonate of potass or soda forms cooling effervescing draughts, very useful in allaying vomiting and thirst. Citric acid is prepared from the juice. The yellow peel or rind is aromatic, and furnishes an essential oil, known by the name of oil or essence of lemons, which is used for perfumery as well as for flavouring lemonade, barley-sugar, &c.

The *lime* resembles the lemon, but is smaller in all its parts, and contains more acid in its unripe state. Many other plants of this order supply edible fruits. The shaddock, a well-known Indian fruit, larger than the orange, is the produce of the *Citrus decumana.* The fruit of the *Glycosmis citrifolia* and *Triphasia trifoliata* are delicious articles of food. The *Cookia punctata* yields a fruit called wampee, which is highly valued in China and India. The fruit of the *Feronia elephantum,* called wood-apple, is eaten by the Indians. From this plant also is procured a gum similar to gum arabic. Its leaves are aromatic and carminative. The fruit of the *Ægele marmelos* is said to be excellent, and to possess nutritive as well as laxative qualities. The leaves of this plant have been used in asthma, and its root and bark are recommended in Malabar in hypochondriacal complaints and in palpitation of the heart. The rind of its fruit yields a perfume. The leaves of the *Bergera Koenigii,* another plant of this order, are stomachic and tonic, and are used in a raw state in dysentery. Its bark and root have stimulant virtues.

AURELIA. A term employed by the older entomologists to designate the pupæ of lepidopterous insects, i. e. butterflies and moths. The word is synonymous with chrysalis, and both were adopted, the first by the Romans, and the second by the Greeks, in allusion to the golden colours with which the pupæ of many butterflies are adorned, whence, in process of time, these terms were employed generally, although the pupæ of the majority of lepidopterous insects have no appearance of gilding. This appearance was eagerly seized upon by the alchemists, as an argument in favour of the transmutation of metals; but the insufficiency of such reasoning was fully proved, both in France and England, by the application of those principles of investigation by which alone the real cause of natural effects can be ascertained; Reaumur, in France, having discovered that it is owing simply to the shining white membrane immediately below the outer skin, which being of a transparent yellow, gives a golden tinge to the former; whilst Lister, in England, imitated the gilding of chrysalises, by putting a small piece of a black gall in a strong decoction of nettles; this produced a scum, which when left on cap paper will exquisitely gild it, without the application of the real metal. Reaumur also mentions, that for producing this appearance it is essential that the inner membrane be moist, whence may be explained the disappearance of the gilding, so soon as the fluids within the pupa have been absorbed by the formation of the limbs of the butterfly. As the term aurelia is, however, nearly obsolete amongst naturalists, we shall defer our general observations upon the nature of pupæ or chrysalides to a future article.

AURICULA (Linnæus). The *Primula auricula* of botanists. This beautiful species of primrose has been, from its native mountains of Switzerland, advanced to one of the first stations in European flower gardens. In these latter, it is now a stage flower; and as no plant has had more pains bestowed upon it than the auricula, so no other presents the effects of skilful management more decidedly.

Originally the auricula was diminutive in bulk, with small trusses of flowers of nearly unvaried colour; but under the treatment of the florist, the whole plant becomes amplified; both leaves and flowers are enlarged; and the latter are not only improved in regularity of form, but diversified with the richest colours in endless variety.

The florist's auricula is a child of art. On the stage it loses almost all its original hardihood; for neither can it bear the winter's frost nor summer's sun. Kept in pots, and pampered on the richest soil, it is preserved from the extremes of the seasons by having roofed stages erected for its welfare. Here it is defended from every unfavourable vicissitude of the weather, and completely under the control of the owner, who gives or withholds water, admits or shuts out air or sunshine, according as his fastidious charge requires.

That dry air is necessary to the auricula is obvious from its natural habitat being lofty mountains; from experience in its cultivation, and particularly from that curious peculiarity of constitution by which it covers itself with dust. This is certainly a defence against rain; and is a silent hint to the manager to be guarded against keeping his plants too moist, more especially when they are in a dormant state.

The auricula is propagated by seed to procure new varieties, and by slips, to multiply and continue old favourite sorts. In raising them from seed, the most important part of the business is saving seed from the best kinds. The usual precaution is moving the breeders away from among inferior kinds, and placing them where they may be in close contact with superior sorts, in order that they may receive sexual impressions either by accident or by the intentional manipulation of the manager. The breeders are assisted in every practicable way to ripen the seed. Decayed or supernumerary florets (or pips, as they are technically called) should be cut off, leaving only the more promising capsules to mature their seed. When these become dry and brown, they should be gathered and kept in a cold and moderately damp, rather than in an over-dry place, till the month of January, when the seeds, freed from the capsules, should be sown.

Boxes, large sized pots, or seedling pans, are used for seed-beds. These should be carefully drained by a layer of gravel or cinders in the bottom, filled with proper compost, shaken and pressed smoothly down full half an inch below the rim, leaving the middle rather higher than round the sides. On the surface the seeds are dropped regularly, and covered with finely sifted compost to the thickness of a crown-piece. Water is given immediately, but so lightly that the surface or seeds be not disturbed. The seed pans are next placed within a frame or hand-glass, where they will be safe from the mid-day sun, from earth-worms and insects. Air should be given occasionally to prevent mouldiness, and gentle watering if necessary. Some florists raise their seedlings on a mild hot-bed. This not only expedites the germination and growth of the seedlings, but brings up many of the weaker seeds, which would not rise at all without such excitement.

As soon as the plants are fit to handle, they are thinly pricked out into larger sized pots, in which they are nursed till the month of August, when they are again transplanted singly into sixty sized pots, or three together at equal distances round the outside of forty-eights. Here they remain to flower; and then comes the most interesting period of their culture. The sower may have raised many that are worthless; and also many that are only third and fourth rates; perhaps a few second rates; but if he gains only *one* first rate he feels all his labour well bestowed!

Successful management of the auricula depends very much on the suitableness of the soil or compost prepared for it. The different substances employed are maiden, or fresh loam; the droppings of sheep, horses, or oxen; desiccated or very old night soil; dung of pigeons, poultry, and geese; blood from slaughter-houses; sugar-bakers' scum; bone dust; leaf mould; and sea or river sand. Portions of all these substances have been used, but without advantage; many eminent florists using only one-third loam, and two-thirds sheep-house dung, and a little coarse sand, all well incorporated together.

Choice auriculas are kept in thirty-two sized pots, and should be shifted about the first of August in every year. Some individual plants may need shifting sooner, especially those which require to be divested of their slips. The slips are taken off at shifting, and potted by themselves; and then also the condition of each plant should be considered and treated accordingly. Such as have been previously shifted, and have improved in growth during summer, will only require larger pots, with an addition of fresh compost. Such as look sickly, should receive a more severe examination, by shaking off the soil entirely from the root, to see whether canker has seized the tuber: and if so, the knife must be applied to cut away all decayed parts before repotting. In potting the lower leaves should be about half an inch above the surface, and this nearly one inch below the edge of the pot. This depth is necessary, in order to allow as large a top-dressing as possible in the month of February.

After being thus shifted and watered, the collection must be placed where there is full air and light, but shaded from ardent or long-continued sunshine, and also from heavy rains. The morning and evening sun is salutary, but not that of the middle of the day. It has already been observed that the stage auricula is wholly an artificial being; so much so, that it cannot bear extreme changes. An equable degree of moisture is necessary for the roots, and a regular degree of dry air is likewise necessary to the leaves. For these purposes, each plant, when it arrives at a proper age, must not only have its own pot, but the collection must have a suitable platform or shelved stage fitted for its reception, raised high enough from the damp of the ground, and with a covering to exclude the sun and rain whenever necessary.

To combine with convenience all the advantages of shade and shelter required by auriculas, a double stage protected by a double roof is certainly best. On one side of the roof may be glazed lights or pannels, and the other boarded shutters of the same dimensions, so that they may take each other's places as the season or state of the plants require. It would be superfluous to give directions for such an erection; so as the principle of its use connected with convenience is adhered to, local circumstances and the views of the proprietor will direct all the particulars of place, form, and dimension. We may notice, however, a very simple contrivance, constructed for keeping auriculas both in summer and winter. It is built in the form of an alcove, placed against a north or south wall, according to the season. Four substantial corner posts are fixed in the ground; those behind are united by a plate five feet from the ground; the front posts have also a plate six feet high; the ends and back are boarded. The roof is covered with pannels, sloping from the front and attached to the back plate by hinges, to admit of their being thrown off. The width of this frame need not be more than about four feet. This will give room for a stage of four shelves, rising one above the other, on which to place the pots. By throwing back the roof pannels a warm shower may be admitted. The front being open allows the entrance of the mildest air and strongest light in winter, and a curtain of mats defends from frost, or from the sun's heat in summer. If such a frame as this, intended for a small collection, were formed on truck-wheels, so that it might be turned to any aspect, it would serve as well for a summer as a winter repository, and answer all the purposes of a double roofed frame.

On such a stage as this auriculas are kept during spring, summer, and autumn ; and if they can be sufficiently protected during winter also. Constant care is required to supply them with water, light, and air, as best suits them, in such quantity and at such times as the experienced cultivator only knows how to afford. In their progress towards blooming, if more than one truss of flowers appear, the weakest must be displaced. And when the preferred truss begins to open its florets, these, if too numerous, must be thinned, leaving no more than will form a well-balanced head of flowers. Small pointed scissors are used to cut out the supernumerary pips ; from seven to thirteen of the strongest being considered enough. Shading the plants while in bloom—supporting the weak stems by hooked wires—giving water in moderate quantities to the roots only—preventing the visits of slugs, woodlice, earwigs, &c., require the daily attention of the florist ; and when the flowering is over his attentions do not cease. The plants must next be removed to the summer station, and there receive over again the necessary treatment, as before detailed.

A fine auricula should have a strong elastic stem, bearing the truss at some height above the leaves. The parts of each floret, are the tube, the eye, and the exterior circle containing the ground colour with its margin ; these three should be proportional ; that is, supposing the diameter of the floret to be divided into six parts, the eye should occupy three (the tube being one), and the ground-colour the remainder. The face of the floret should be round, not starry ; the anthers should be bold, filling the tube well, and surrounded by the raised edge of the tube, called the cup. The eye round this cup should be a regular circle, purely white, and smooth ; encircling this is the ground colour, which should be intense and rich ; either in an unbroken band, or in very distinct patches, somewhat suffused into the margin. The ground colour should be black, purple, blue, or bright pink ; but glowing scarlet, or deep crimson, edged with green, are highly prized.

AURICULA (Lamarck). VOLUTA (Linnæus). The animal of this genus has its foot entire. The shell is thick, solid, more or less smooth, oval, oblong ; the spire short and obtuse ; the aperture entire, oblong, enlarged, rounded in front, becoming much narrower backward ; the edges disunited, the right constantly thickened and turned outwards ; the left, or columellar side, almost always presenting one or several teeth, or thick decurrent plaits, on the columella.

These shells were blended promiscuously with the *Volutes* of Linnæus, from which Bruguière removed all those not possessing a notch at the base into his genus *Bulinus*, not considering that the plaited, or callous columella, distinctly indicated the dwelling of a differently organised animal. Lamarck has consequently constituted the present genus. He had imagined that the *Mollusks*, with a plaited column, the aperture without a notch at the base, and the margin smooth and sharp, were river shells, and therefore formed them into a separate genus, under the name of *Conovulus ;* but, from the subsequent observations of De Valenciennes, it was discovered that they are terrestrial, and Lamarck has included them in the present genus, which he divided into two ; first, the species having the right lip reflected ; and secondly, those having the right lip plain and sharp. De Blainville has divided this genus into five species ; the first having the columella redge, with three thick plaits or folds, and the internal part of the right lip denticulated its whole length, as in the *A. scarabæus* here figured ;

A. scarabæus.

the second species having the columella with two thick decurrent plaits, and one tooth behind (constituting the genus *Carychium* of Muller, and *Phoetia* of Gray), as *A. myosotis ;* the third species, which have only two decurrent folds in the columella, as in *A. Judæ ;* the fourth species, in which only one plait in the columella exists, as in *A. Sileni ;* and lastly, such species as have their lips without either teeth or plaits, as in *A. lineata.*

The number of recent species thus circumscribed amounts to eleven or twelve, of which three very small ones are European ; the others are from the banks, particularly, of the Indian and American Archipelago. Lamarck enumerates seven fossil species, and De France nine, but some of them are true *pedipes,* and the turriculated species certainly are not of this genus.

The name is derived from a fancied resemblance to the ears of some animals.

These shells seldom present any vivid colouring or elegant pencilling ; they are for the most part covered with a thick epidermis ; but they are frequently delicately sculptured, and form a pleasing and interesting genus, easily distinguished from the *Volutes* by the characters pointed out. Their rank in modern malacology will be seen by referring to the article *Auriculacea*, of which they form the second genus.

AURICULA JUDÆ, a fungus so called, belonging to the genus *Exidea*, found on decayed trunks of elder.

AURICULACEA (De Blainville), a portion of which were blended with the widely-diffused Linnæan genus *Voluta.* The bodies of these molluscous animals are spiral, with subcylindrical tentacula, inflated at the summit, clumsily contractile, having the two eyes placed at their internal base ; one upper tooth is opposed to a tongue provided with little hooks. The shell is thick and solid, the opening more or less oval-shaped, always much larger, rounded in front, and somewhat narrowed by one or more teeth, or thick columellar plaits.

The animals of this family are phytophagous, and constantly inhabit the sea-shores, being even sometimes momentarily covered by the water.

This is the second family of the order *Pulmobranchiata*, class *Paracephalophora*, in De Blainville's Malacology.

AUTOMOLITE. A species of the mineral termed corundum stone. It occurs at Fahlun, in Sweden, and is usually imbedded in talc-slate, along with galena. Automolite resembles both ceylonite and spinel, but it is distinguished from the former by its more distinct green colour, foliated fracture, inferior hardness, and superior specific gravity ; and from the latter by its colour, inferior lustre, perfect cleavage, low degree of transparency, inferior hardness, and greater specific gravity.

AUTUMN. The third in order of the four seasons into which, in the temperate regions of the world, the natural year is divided; and in the kalendar, including the months of August, September, and October, or nearly equal times on each side of the autumnal equinox, or the time when, about the 22nd of September, the day and night are equal to each other. But nature is not regulated by the kalendar, either as to the time or the duration of autumn, or of any other season. Much depends upon the latitude,—not a little upon the surface and the proximate surfaces, and on the currents of the atmosphere and the sea—something depends upon the character of the previous season—and even the culture which man bestows upon the soil has no inconsiderable influence upon this season. Where, by skill and industry, he subdues the wildness of nature, clears the wild, drains the marsh, enriches the sterile field by manure, shelters the exposed one by trees, and, generally speaking, obtains a rich and abundant crop, the elements work in concert with him, and send him a delightful autumn in which to gather it in, and also to take his sport in the cleared fields after it is under the thatch, or to prepare for another year that portion of the crop which is to abide the winter in the fields. And it is not for his crop and his immediate comfort alone that the season co-operates with his skill and industry. The tree consolidates that portion of wood which the year has produced; brings forward its buds, whether for fruit or for an increase of twigs, full and round; and wraps them up in their safe hybernacula, until a new year shall call them into action. The flocking birds are upon the cleared fields betimes, consuming the seeds of the annual weeds before they have begun to germinate. The air is free, dry, and repellent of the premature inroads of winter; and all nature is gradually prepared for that healthy repose which is the surest pledge of vigorous and useful action in the year which is to come.

On the other hand, if man neglects his duty, the neglect is felt by all nature, though the punishment, as in justice it ought, falls most heavily upon the wrong-doer. If the water is allowed to stagnate, the banks of the stream to become marshes or quagmires, and the surface of the earth to run wild, there will not only be poor crops on the few cultivated patches, from the constant warfare they must maintain with the invading weeds, but the very seasons will appear to rebel. Autumn, deprived of its proper accompaniment, will deluge with rains and blight with hoarfrosts; for it seems to be a law of nature, that, if man will not improve the bounty which she sets before him—the talent which she offers for his use, she withdraws what he is too indolent for improving, and strikes in vengeance against that which he abuses by want of industry and skill.

Thus, in thickly inhabited countries, autumn is in some respects a season of "man's making," at least in so far that, if he would have it good and pleasant, he must conduct himself so as to deserve it.

But besides thus being a season, in some sort, of an artificial nature, or at least, in peculiar places, having its characters modified by artificial causes, autumn is altogether a local season, known only in particular latitudes. Summer or winter, or an alternation of the two, is found over the whole earth, from the one pole to the other; but spring and autumn belong to particular latitudes only, and in these they must be, to a certain extent, deserved and won before they can be obtained; and it is worthy of remark, that where these seasons exist, or can be obtained in their best characters, they are always the most favourable for the development of the human powers, physical and intellectual, and the best suited for human enjoyment.

At the equator, within the tropics generally, and often without them, varying in range with surface and situation, there is no autumn—no season analogous to that which we of temperate climates call by the name, and in the abundance of which we all with so much reason rejoice. It is true that, in those regions, fruits ripen and leaves fall in the same manner as they do with us, but not at the same times, or for the same reasons. The fruit does not ripen in order to secure a germ during that rigorous time when the plant may perish. When one crop of the tropical fruit tree ripens, there is generally another half grown, and a third in the blossom. The pause in the growth of the tree, too, is a pause from drought and heat, not from cold; and the leaf does not fall then. Its polished epidermis only concentrates to resist the evaporative action, something in the same manner as the leaves of our evergreens, which have a similar kind of epidermis, consolidate in the winter; and, as in these, the old leaf does not fall till the season of growth has returned, and the young leaf of that season is so far advanced as to take its place, or supply its function. The shrub often loses its leaf, and the herbaceous stem, although in the course of one humid season it grows as much as with us would be considered no mean tree, withers, or is parched up; and sometimes the drought is so intense, that such stems take fire by the collision of their hard and silicious bark against each other, and the conflagration spreads wide, invading the forest, and raging till the whole district is a ruin. But in whatever manner and to whatever extent the power, the change, or the destruction of vegetation takes place, it is not an autumnal change in our sense of the word. It cannot be said to be a preparation for any season, so much as the direct and marked effect of that change from humid to dry which has already taken place.

Then, in the time of its occurrence, it abides less by the kalendar than the autumn of temperate regions, and the action of the earth's surface has more influence in bringing it about than the mere periodic time by the sun. If solar heat regulated the seasons, without the action of the different surfaces upon each other, the two equinoxes would be midsummer days under the equator, because there the sun on them passes directly over head at noon; and, within the tropics, two midsummer days would be carried into each hemisphere every half year alternately, gradually coming nearer to each other, till they met in our longest day, when the sun was over the northern tropic, and in our shortest day, when he was over the southern. But the solar action is so powerful, that it revives the energies of the earth to the utmost, and a new action between surface and surface is produced, regulating the time, the duration, and the intensity of the seasons of vegetable action and repose.

The direction varies, as well as the intensity and duration. At times it is an action between hemisphere and hemisphere, nearly in the direction of the meridian, as in the case of the Indian monsoons; at other times it is between the parched district and the fertile, as between the African desert and the valley of the

Niger; sometimes it is between the mountains and the plain; at other times between the land and the sea; and the periods vary so much, that in some instances, while the one side of an island, or narrow piece of land, has rain in abundance, the other side is parched up with drought. In one place, the alternation takes place only once in the year, while at others it takes place twice, and there is a double season of fertility; and in some favoured spots, where the currents meet laterally, there are showers all the year round, and perpetual growth and fertility. No general theory of the tropical seasons can thus be established, either as to time of occurrence or duration, and so they must be made the subject of local observation for every place. But still, even in the wild and uncultivated places, there is an autumnal pause when the season of growth is over. Very many of the herbaceous plants which die down have tuberous or farinaceous roots, into which the substance of the plant is there concentrated, and the rude people dig these up, and roast them as substitutes for bread; while those which are more advanced and thickly peopled, and most cultivated, are, at a distance from river courses, obliged to do it at vast labour from tanks of water collected in the wet season, or from wells, which have sometimes to be dug to the depth of 300 or 400 feet; so that, if they are exempted from the labour of building close houses, preparing warm clothing, and keeping constant fires, they have not their sunny skies for nothing, but must toil as hard as they of temperate climes.

In these places, many of the smaller animals disappear in the seasons of drought; some by perishing and leaving only the eggs to produce a new race, as is the case of many tribes with us during the winter; others get into the ground or otherwise hide themselves, and *hybernate*—or perhaps *æstivate;* for, in our sense of the words, the dry season may be called either winter or summer, as it has the sterility of the one and the heat of the other. The larger animals also prepare for the season, but it is by casting part of their covering, and not getting an addition to it as exposed animals do with us against the winter. Many of the birds too, migrate, and they do so because the parched countries cease to yield them food. But though in those tropical regions, there is plenty of change, there is no autumnal action and no autumn. As little is there any spring; for by the time that the violence of the opening storm is so far over that men can come out of their houses and hiding places and survey the fields, the world is absolutely new. The fields which when last seen were dry and barren as a rock, are green with leaves and gay with flowers, as if Eden had been charmed forth from the wilderness, instantaneously and by magic. Sometimes they appear new to a greater extent, for the first floods are often so violent that they uproot trees, tear up the earth, and scatter fragments of rocks and banks of rubbish, till the general features of the country are entirely changed; yet these rocks and that rubbish remain but brief space before they too are vested and shrouded in the luxuriance of the new vegetation.

Such is the one extreme of season, that in which summer, varied only by drought and humidity, may be said to hold unbroken sway all the year round.

Let us now take a hasty glance at the other extreme, that in which winter and summer may be said to divide the year; and where that which might be called autumn or spring, has no fixed character as a separate season, but is a sort of conflict between these two. The knowledge of this extreme is as necessary as that of the other, before we can have correct notions of the character and value of autumn in the temperate climates; and, indeed, we can understand nothing in nature rightly, if we do not take it in connexion with its class.

The common notion is, that the cold increases with the latitude, till we reach the pole of the earth's rotation, and that there it is a maximum, the capital and throne of winter as it were; and that this would be the case upon mechanical principles is unquestionably true, because it accords with the ratios in which the sun's light falls upon the earth, supposing the surface uniform. And up to a certain point we can trace a near approximation, if not a perfect accordance to the mechanical law; or if there are local deviations, we can trace them to local causes. But a mechanical theory, though the splendour of Newton's discovery long made it be regarded as a universal instrument of science, and many still look upon it as such, is not a complete, or altogether a safe guide, in matters of natural history; and there is thus much in it of rather a provoking character, that it applies best in those parts of the inquiry where we could do best without it, and fails where we need it as our only guide. In a great measure, at least, it is so with the increase of cold toward the poles, or the seat of its greatest intensity. The accounts of the recent voyagers by sea and travellers by land in quest of a north-west passage (or any thing else they could find) on the north of the American continent, cannot be received as demonstration, though they must be admitted as truths so far as they go. Now the inference from them is, that on the north of America, the maximum of cold is about the latitude of the magnetic pole, or about 71°. The trend of the ice in the North Sea, and observations that have been made at many points of the circumference, shows that, in these high latitudes, the *isothermal* lines, or lines of the same temperature, do not lie on parallels of latitude, or nearly so, even supposing that allowance is made for differences of surface and elevation. Thus we can no more find, in the regions of the poles, a definite parallel of latitude at which to fix the maximum of average cold for the year, than we can find one in the regions of the equator from which to date the maximum of average heat: we find the same temperature more southerly in one latitude, and more northerly in another; and whenever we find the cold far to the south, spring and autumn are always less marked; and they are always more so, and even a greater range in latitude, as the cold is further to the north. Thus if we take the latitude in North America, which corresponds to that of the coast of the Channel in England, we find that in America there is hardly any spring or autumn, and that on the coast of the Channel, except in bleak situations, there is little, if any thing, which an inhabitant of Canada, even considerably to the south of the parallel of the Channel, would call winter.

In the very extreme of the cold, whether situated more or less to the north, there is very little in which autumnal appearances can display themselves. The presence of snow and ice covering the land and concealing the sea, and their partial or total absence, are the first markings of the arctic seasons; and it is not a settled point whether the absence of any thing that we would call vegetation there be more owing to the sunless winter, or the perpetual beating of the sun during the nightless portion of the summer. For a considerable distance, there are few flowers, and what may be considered as the trees, are not taller than the smallest of our under shrubs; while the few trees that do raise their stunted forms to the height of two or three feet, are chiefly evergreens, which make shoots a tenth of an inch long in the course of the season of growth, that does not begin till June is partly elapsed, and is over by the end of August, or early in September. There are some berries; but there are no fruits, and not any large farinaceous seeds to ripen. The first grasses that appear are often viviparous, that is, the seeds germinate on the stems, and the little plants take root in the ground, before the snow descends to protect them from the keen atmosphere of the winter. But there is no autumn; no fall of the leaf; no preparation of vegetable nature for abiding the blast. There is, in fact, no leaf to fall; and in the other vegetables, preparation for the season is not required; for, during the winter, there are no vicissitudes to try their strength, no rains, winds, frosts, and sunny blinks alternating with each other, which require a certain degree of stubbornness in the plant, so that its action may not be excited by the one and killed by the other. Hence, plants from these regions, or from great heights on the mountains where the climate is in some particulars similar, can but ill abide the changeable nature of our winters, even in the most sheltered situations.

The arctic plant, not having to ripen and prepare for the winter, can continue its action during the whole of the short summer; and as the plant requires little or no preparation, the atmosphere gives but slight announcement of winter coming. After the sun has got from a fourth to a third of its low and sloping circle, below the northern horizon during the night, and there is yet a bright twilight in that part of the sky, some day is more than usually tranquil, and the clouds "castle" about sunset, and show tints more rich than usual, or the sky remains cloudless, but there is a greenish yellow tint on the twilight portion, across which the auroras play their feathery beams toward the zenith, now concentrating into one radiant pillar or curtain, and anon breaking and starting into a thousand forms. The rude people know the sign (for the less that there is to study on the earth men contemplate the heavens the more, and hence in part the peculiar superstitions and mythologies of those arctic tribes)—they know the sign, and if they be not "snow-dwellers," they betake themselves to the winter hut. The night turns, the north-wind is up, and the moisture in the atmosphere, which appears to have been increased on purpose by the heat of the halcyon day, is congealed into small crystals of ice. Down it pours, ere the ground has had time to be frozen to any measurable depth; and as the north has gotten the victory, it rages away for days or for weeks. The wind roars and the snow drives, not in flakes, but in fine powder as sharp as that of glass; and the grouse and other field birds, which winter there, are driven from those places into a closer shelter; but are often caught by the storm, and compelled to drive as it lists. Then the fur-clad owl comes abroad to the slaughter, and the arctic bear howls on the beach for another meal ere he takes to his repose. This storm usually comes again and again, with tranquil pauses between, or rather it pauses in one place by shifting to another; but generally it is so violent, and confined within so limited a range, that its duration is not very long. When it is over, the atmosphere is so completely cleared of moisture, the surface of the earth so mantled in snow, the sky so clear, and the moon so bright, that the people almost forget the absence of the sun; and though the cold is piercingly severe to a stranger, those who are inured to it feel it bearable enough, even in their habitations of snow, till the season comes round, and the temperature rises till the snow begins to melt, when they become unhealthy and uncomfortable Nature prepares the wild animals for this season, by an increase of covering, whether of feathers or of fur; and their colour changes wholly or partially to white, which renders it still a worse radiator of heat.

Such is the transition from summer to winter, the only semblance that there is of autumn in the regions of extreme cold. There are, no doubt, some other preparations. The water birds which abound on the shores and banks, and in the open places, as far as they can for the ice, as well as multitudes of those birds not habitual swimmers, that resort to those places to rear their broods on the abundance of insect and other small life, which the uninterrupted action of the sun calls forth during the summer, migrate southward before the storm breaks; and it is said that the whales set out on their migrations. That the northern seas are not then adapted for those unwieldy animals, which do not appear to keep breathing holes in the ice like the seals, and whom such a means of respiration would not suit, as they must range far, and also near the surface, before they can make a meal of the small substances on which they feed, is certain; and it is also certain that they do not resort to the European shores further to the south. Hence there is at least a probability that they range the ocean far and wide; and it may be, as is said, that they double Cape Horn, and find their way to the northern parts of the Pacific. The voyage is a long one, but the whale, notwithstanding its bulk, is a fast sailer, estimated to make way at the rate of more than twenty miles an hour, and feed at the same time; so that, from Davis's to Behring's Straits would not be a voyage of many weeks. The mother whales are said to take their cubs round in that manner, so that in their youth they are tempered to all seas. That whales do sometimes pass from the one side of America to the other is certain: but whether they pass by Cape Horn, or find a shorter passage in the north, which our navigators have sought for but not found, is a point not absolutely settled; though, as they remain on the east side till the ice begins to close in northerly, it is most likely that they make their autumnal trip by the south, but how they return is not so well ascertained, as they are found early in the season as far to the north as there are openings in the ice. That they pass in some way is proved by the fact that spears and harpoons of a form used only in the one sea, have been found in the bodies of whales captured in the other.

Having now adverted to the two extremes between which the countries having a distinct and characteristic autumn lie, we shall notice some of the phenomena of that season in their intermediate places. But here it is by no means easy to speak in general terms, inasmuch as no two countries have their autumn exactly alike. Therefore, as our observations must be either local or vague, we shall make them as few and brief as possible.

The general appearances which, in our own latitude, mark this season, and distinguish it from other seasons, must be familiar to every one who has eyes. The shortening of the day much faster than the apparent diminution of heat, the general transparency of the air, the distance to which the view extends, and the bracing effect which one feels more than at any other season: these peculiarities arise from the diminished evaporation, and that again is owing to the dry and drying state of vegetables, the leaves and barks of which are gradually ceasing to have any action, and of course do not give out so much humidity, or so act upon and alter the state of the air, as when they are in growth. The cleared fields and the dry stubble contribute to the same result, as they do not "steam upwards," either as when they are drying in spring, or when they are supporting growth in summer. The transparency of the air does not depend so much upon the absence of moisture, as on the absence of evaporation; and the latter is, in many cases, not so much owing to the want of evaporative power in the air, as to the want of humidity to be evaporated. As there is less living action going on upon the earth, than while vegetation is in progress, the beams of the sun heat it more while they fall upon it, and it cools faster after they cease to fall. Thus, it approaches in a certain degree to those tropical scenes which are intermediate between growth and parching; the days, too, are nearly of the tropical length. Thus, dew forms more readily upon the surface than at any other season; and in those places which are shielded from the direct action of the sun, it continues longer ere it is dissolved.

In districts which are a little upland, or otherwise colder, fogs creep along the surfaces of the lakes and the courses of the streams, and generally over moist surfaces. These are more owing to the condensation of moisture in the air which is cooled by these surfaces, than to evaporation from the surfaces themselves; for autumnal fogs do not drain the moisture like the fogs of the early season. But in cold districts they continue during the night; and the late corn, the leaves of potatoes, the after-math of red clover, and other plants which are rather delicate, get cold just before dawn, and dew forms on them, and often congeals into a sort of hoar frost, which, though gone before it can be seen in white spiculæ, prematurely whitens the oats and other late grain, and blackens and shrivels up the leaves of green plants.

If the autumn advances dry and kindly, and without frosts and falls of rain (for if the first of these come it is almost sure to be followed by the second), as the atmosphere becomes too cold for retaining its moisture, the changing leaves, as the wood ripens, produce an endless variety of tints. Yellows, browns, and russets, in various shades, with here and there a patch of dull red, are the usual colours of our European trees; and if the tints do not come out free and clear before the leaves begin to fall, it is a sign that all is not well with the groves, copses, and hedges; and if the season be very unfavourable, or the place bleak and backward, the leaves hang dull in a sort of unhealthy green, spotted with mould under the epidermis, without the pleasant smell of leaves that have performed their office well, and are fading in a kindly manner; and these often refuse to cicatrize and come off, but cling in withered patches killed by the frost, till the storms of winter drive them off by force. There are some, however, which retain their leaves after they have ripened, and faded in an apparently healthy manner into the brown of inaction. The common beech, in cold and elevated situations, is one of these, and it often retains the old leaves till the young buds, which in the beech are always rather advanced in the autumn, have half expanded their leaves. On rich and warm soils, where the trees attain a large size, it is not exactly so, though a few tufts often cling; and if suckers are allowed to grow at the roots, the leaves adhere on them after they are cut from the parent tree. In this habit there is a sort of partial approach to the evergreens, only they retain their leaves green, though inactive, during the winter, and do not revive into action in the spring, though shed at a more advanced period of the season than the discoloured leaves of the beech. It is worthy of notice, that when the beech retains the whole of its old leaves during winter, it also gets the slow growth of the hardy evergreens, and forms harder timber than when the growth is more vigorous; but though harder, it is brittle, of inferior quality, and rots equally soon.

There may be exceptions, but it is a very general law in the autumnal fading of the foliage of trees, that those species, which, in their native habitats, are exposed to the greatest vicissitudes, fade through the most numerous and varied tints. American deciduous trees and shrubs, till a latitude as far southward be gained as that in which the deciduous cypress (*taxodium disticha*) is prevalent, are subject to severe alternations of heat and cold in the spring—far more so than the trees of any of those districts of Europe, where deciduous ones form the chief part of the forests. American trees accordingly fade through a great variety and brilliancy of tints; and as they continue their varying hues for a considerable time before the leaves begin to fall, or even to show symptoms of shrivelling and decay, they add greatly to the beauty of grove and coppice scenery during the autumnal months. The shrubs of our more bleak and northern districts, and those of Lapland, in both of which there are contests between summer and winter, in the brief time which may be called spring, have partially the same habit. Trees of more southerly places, which have no frost to contend with, after the buds begin to unfold, have no such rich variety of autumnal colours. When they do fade ere they fall, they fade into a dull and pale straw-colour, or they are spotted with the depredations of small fungi. But many of them come late, and fall with the first frost, or rather with the sun after it, covering the ground with leaves still green and apparently unchanged. The common mulberry is a remarkable instance. It is further worthy of remark, that the leaves which thus fall at once, or yield to the ravages of the fungi, have their epidermis, thin, tender, and without gloss, while those which pass through the richer tints have it compact, and generally to a considerable extent glossy.

But the autumnal woodland, independently of its scenic beauty, offers a wide field for study—a field far too wide for coming within the scope of a general article of moderate length, even though devoted exclusively to the subject. Some notices respecting it *may* be found in the particular descriptions of the groups and genera of forest trees, and to them we must refer the reader.

But though the autumn is the time when the regular vegetation, which buds in the spring and prepares its flowers and seeds during the summer, begins to suspend its action, so that it may, in repose, pass the winter uninjured; yet the autumn has a vegetation which may be considered as more peculiarly its own, a comparatively short-lived vegetation, which begins and ends with the season, and of which even the vestiges are in general gone before the winter. Allusion is not here made to the artificial productions of the garden, many of which are finer, both in their forms and their colours, in autumn than in the strength of the summer's heat, but to the productions of wild nature, which have no human hand to tend, and in many instances no human eye to heed them. The proper wild crop of the autumn, which appear in forest, field, and wild, coming one sees not whence, springing up with vast rapidity, generally melting in the rain, and leaving hardly a trace behind, are leafless and flowerless plants—the *fungi,* in all their varieties of size, form, and habit. No doubt some of them make their appearance at other times, and they subsist upon animal matters as well as upon vegetable, but never upon matter of any kind till it has ceased to live, and corruption, in some of its forms, has begun to work upon it. It seems, indeed, that corruption is the only *nidus* in which the *sporæ* of this singular race can come to life; and as many of the species are microscopic when developed to the extent of their growth, we need not wonder that the germs exist in places to which we can discover no visible entrance.

It is in the autumn that they appear in their myriads—on fields, on the bark of trees, on stems, on leaves, on heaps of rubbish, in humid places, and in places which are comparatively dry, but never wholly immersed in the water, as water dissolves their flimsy organisation. The whole race are feeders upon the refuse which the rest of nature has cast off in the course of the season of action. Many of them are offensive to look on, a very considerable number are poisonous to man, and still more are suspicious; yet there are insects and other small animals to whom even the most offensive of them appear to be welcome. What general purpose they answer is not accurately known, and it would be foreign to the object of this article to inquire. But their numbers are sufficient to show that it must be one of general importance; and as the time of their life is that of the decay and death of the seasonal part of living nature, it may perhaps be conjectured that they in some way work up and prepare the waste, so that it may serve better for running the course of life anew. We have to do with them only, however, as forming a character of the autumnal season; but more minute accounts will be found under the names of the principal groups and the more remarkable genera.

As the autumn advances, thousands of little creatures are busy in storing an endless variety of substances with the germs of life, all so placed and provided as that they shall pass the average winter uninjured, and find the proper nidus for their development and the proper food for their growth and support, when the returning energies of the young year shall call them to activity. Others which could not bear the weather or find the proper food, hide themselves beyond the reach of danger, and seal up their dwellings till the time of revival comes. There are also some which appear to get a new economy for making the autumnal preparation; some races which have been all females for many successive generations during the summer, and have been, race after race, produced alive, or at least so near it, that they attained the size of maturity in a portion of a day, appear as male and females for the production of those eggs which are to subsist during the winter, and continue the race of their own organic energy, for ten or twelve generations, as before. This, which is well authenticated, is one of the most singular facts in the whole animal economy, and puts one in mind of what is alleged of some fruit trees, that they can be continued for a certain time by the graft in the bud, but ultimately die out, if they are not renewed by a return to the seedling. The whole of the preparation which is made for the surviving of the winter by the progeny of those creatures which are unable to bear its rigours themselves, are among the most curious points in the whole curious field of zoology.

The spiders are a race whose habits are peculiarly worthy of study in the autumn, which is with them the grand season of bustle and activity, in house, garden and field; and taken on the whole, they are highly useful to man. There is no species which commits depredations on any thing useful; for though we often hear of the injury done to fruit trees by "the red spider," the red spider is not a spider of any sort, but a species of coccus. The whole of the spiders, without one known exception, feed upon animal substances; they almost universally kill their own prey; and the whole of that prey is in some respects either injurious or annoying to man. In its feeding, the common house fly is, indeed, perhaps more useful than injurious, because it is a sort of scavenger in its way, and consumes matters, the accumulation of which would be offensive. But its familiarity and its numbers render it troublesome; and, in autumn, it often becomes a nuisance. Many insects get active at the time of preparing for the winter; but the house-fly gets languid, and in houses which are surrounded by rank vegetation, and where matters are conducted in a slovenly manner, it so throngs them as to be a pest. Now this insect is a favourite food both with the house and the garden spiders, and they set snares for it, in all places where it has a chance of passing; and the eggs of the fly are so numerous, and deposited in places where they are so safe from injury, that if the spiders were not to cut off tens of thousands, the flies would multiply till they became an absolute plague. In the gardens they snare many other races; and they do so when these are ranging about and depositing their eggs in places where the caterpillars, or larvæ, would generally, in some shape or other, be hurtful to vegetation. The beauty of the web, especially that of the large garden spider, the skill with which it is placed, always in what may be considered as an insect thoroughfare, presenting its meshes in the very line of the insect passage, and being proof against a considerable degree of wind and rain, the industry with which it is repaired when torn, or replaced when any part becomes too dry in its consistency, are all perfectly admirable. This is not the place for entering upon the details, as these will be found under the names of the creatures themselves; but it is impossible to avoid remarking that if there were no creatures preparing for the winter but the garden spider, there would still be an ample field for observation. Suspended in its central spot, with the head downwards, which gives the animal the advantage of the impetus of its weight, both in darting along the lines, and in holding on with its claws, this spider feels, without the trouble of watching, the vibration of every part of the web to the most distant line, and also the general character of that which throws it into a state of vibration. But, even then, there is always a thread in readiness, by means of which the creature can drop down and seek safety on the ground in case of danger. We are ignorant as to the precise nature of the senses, or substitutes for senses, by means of which these small animals act; but it is not on that account the less curious to observe the tact with which this species of spider appears to ascertain what sort of substance is on the web. It is not by *sight* certainly, as little is it by what we call *touch*, for the portion of the foot with which the state of things is tried is covered with delicate hairs; but still there is an instinctive discrimination. A bit of leaf, or any other inanimate substance, is not advanced upon directly, the spider and web are thrown into a vibratory motion for a little while (the equal bearing upon all the main braces of the web, and the perfect vibration which the occupant at the centre can produce, notwithstanding the unequal lengths of the braces, are no bad mechanical study); and if it cannot be cleared by that means, the spider advances to it and cuts it adrift, using a *gy* to steady it, if there is a chance of a second entanglement in its fall. If the prey alights, not very strong, or with too hard a covering, it is instantly pierced by the fangs; but if strong, and not easily pierced, it is shrouded in web; and the dexterity with which it is suspended by a stout thread, and twirled round for this purpose, is worthy of notice. If another spider (for the disposition to kill extends as fully to their own tribe and species as to any other), it is a matter of exertion. As the warfare is one of enmeshing and not of biting, weight appears to be admitted as a certain means of victory, and accordingly the stranger tries the vibration of the web before he advances, and if he finds the tenant too heavy for him he escapes as fast as he can. If he finds the weight suit him he advances, and the instant that his full weight is on the web, the owner is off; he drops down, but still with a thread, escapes to a plant, or posts himself at the end of one of the main braces, but without resting all his weight upon it. From that position he tries the weight of the assailant; and if he has taken an over estimate before, he darts along with so much impetus, that the invader generally pays for his temerity with his life. If the motive which put him to flight is confirmed, or remains doubtful, he retains his post, but without bearing his weight on the brace. The claws of one foot are, however, ready to cut it adrift if the case require. The assailant gains the centre, and tries all the radiating threads for the owner; and, though that is not so clear, as neither of them is very powerful without the assistance of the web, he *may* sometimes try if there is a descending thread of escape. If he finds the place of the lurker, he makes straight for that; but if the lurker is a good tactician, and he is seldom deficient, just as the enemy comes to the single thread, that thread is cut, and down drop both web and invader, often with so much velocity that, with the injury of only a small portion of the web, the invader is flung sprawling on the ground, and the owner of the meshy tenement returns in safety to the remains of it, and repairs the injury at his leisure. These rencounters do not very frequently take place naturally, as each individual in general keeps quiet and constant possession of his own web, but any one who chooses to make the necessary experiments may see them as often as he pleases. The autumnal labours of all the spiders, though differing considerably from each other, are curious. The particulars will be found under their names; those of the species of which these slight notices have been given, under the title Epeira.

The habits of those more minute members of the animal kingdom, the labours which they perform, the organisations by means of which they perform those labours, and their uses in the economy of nature, are all very curious, as well as highly instructive; and the instruction which we may derive from the right study of them, is superior in kind to that which we derive from studying even the noblest examples of human art. In the study of human art there always mingles more or less of human vanity, the effect of which is to narrow the mind; and when the model is of high merit, it destroys our confidence in ourselves, so that we become mere admirers, or at best imitators, in many cases, when the exercise of our own free spirit and undaunted hope would have led us to excel, or at least to equal. In spite of all his roughness, want of obedience to the canons of learned taste, and occasional infractions of the laws of learned accuracy and propriety, there is a freshness — a something which one can hardly define, and dare not refrain from liking, about the man who has run his own course, which one does not feel in the more polished, and as far as the mere matter of instruction goes, the more instructive imitator who constantly feels the superiority of his masters. This indescribable something always gives us much pleasure, and not a little of that pleasure arises from the conviction that it is pleasure communicated to us by one who must have felt it strongly himself.

This is more the case with natural history than with any other subject; and those portions of natural history which come before us every season, and every day of the season, like that of the garden spider in the autumn, are the points at which even every child may take hold on natural history, so that it may be made the vehicle of much useful knowledge—of knowledge really useful, as, while it informs the head, it keeps alive the feelings of the heart, and makes goodness not to lag behind information—not only with pleasure, but without hindering the most active employment in the common business of life. One, therefore, beholds with pain the neglect or abuse of any means by which this great fountain of information, pleasure, and the love of virtue (for it combines all the three pretty equally), might be more freely opened to all the people, so that they might enjoy it more abundantly, more pleasantly, and healthfully.

But from the manner in which the subject is treated, especially in those parts of it which, like the labours of the garden spider, are calculated for exciting thought, and producing a reflective habit most readily in the young, the thought is suppressed, and the wisdom turned to error, by the injudicious comments which accompany the recital of the facts. The grand source of error which mingles so copiously with these is the imputing of forethought, plan, purpose to the animals, differing in degree or mode, but the same in kind, as that which regulates the conduct of reflective man. In principle, this places man in the very same relation to his Maker as the spider is, which breaks down all moral obligation, and disposes man to follow the other habit of the spider, and, by the withdrawal of the tie of moral affection, to eat up his brother whenever strength suffers and opportunity favours. This subject is one of a very serious nature, as it destroys the respect and confidence which should be reciprocal between man and man, makes merchandise of the affections, undermines the foundation of individual happiness, and predisposes to crime by the removal of every restraint but the penal statute, which men, in the hour of secret temptation, always trust to their good fortune that they shall avoid.

This subject is so often alluded to in those parts of the present work which are intended to impress upon the reader the nobler use of the application of natural history in promoting human happiness, that, though there are many to whom no explanation of this departure from the common practice will be necessary, yet, for the sake of others, a sentence or two may be given. There are in this country plenty of naturalists, but the fashion of the times confines their labours in the way of writing to reports and monographs on single points, which, though of great value to the professed student, are not adapted for general readers. The books for these, and especially those which profess to instruct the young in the study of natural history, are not the productions of naturalists, but of compilers, who cull from all quarters those anecdotes and descriptions which appear to be the most striking and effective; and who, by way of giving the whole an air of originality, interlard their works with descants which have the pernicious tendency above alluded to. We have no such objectionable matter in the old books, which *were the productions of authors*—Ray's "Wisdom," for instance, or Derham's "Physico-theology"—which makes us regret that the Rays and Derhams of our time will not condescend to school the public by means of books as wholesome in substance as they are popular in form. Of course we do not mean to affirm that all the popular literature of the present day has this tendency. On the contrary, the desire to illustrate the greatness and goodness of the Creator, by a reference to his works, appears a peculiar characteristic of modern cheap literature.

AUXIS. A genus of spinous-finned fishes, belonging to the mackerel family, and partaking partly of the characters of the mackerel, and partly of those of the tunny, though it does not, at least in the European species, attain the size of the latter. It has the corslet of large and rough scales on the thorax, and the pectoral fins of moderate size, as in the tunny; but the two dorsal fins do not run into each other as in that fish, they are separated as in the mackerel. There is one European species, found in the Mediterranean, which is the *Scomber Laroche* of Risso. It is both a handsome and a valuable fish. The colour on the upper part is bright blue, marked with waving bands of a blackish colour. The flesh is of a deep-red colour, but boils a little paler; when fresh, it has something of the flavour of salmon, and is much esteemed. In the West Indian seas there is another species, which is much sought after for the table; it is there called the tunny, and sometimes attains the size of that fish, or from 400 to 500 pounds in weight; but those which are of smaller dimensions are more palatable. Like all the rest of the family, they are surface fishes, keeping in shoals, and frequenting particular stations only, but, like most surface fishes, they are easily caught.

AVENS, the English name of what botanists call Geum. Linnæan class and order, *Icosandria Polygynia*; natural order, *Rosaceæ*. Generic character: calyx ten-cleft; segments alternately smaller; corolla five-petaled; stamens inserted in the base of the calyx; styles persisting, jointed or kneed, hooked or bearded at top, sideling; receptacle dry; caryopsis many, with the styles attached. There are twenty-one species, two of them British weeds. Some of them are showy, and have a place in every flower garden.

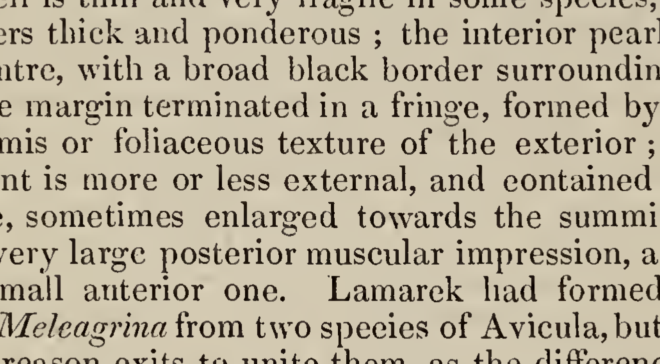
AVERRHOA (Linnæus). A genus of two species, of beautiful trees, natives of India, China, &c. Linnæan class and order, *Decandria Pentagynia;* natural order, *Oxalideæ*. Generic character: calyx five-cleft, or of five sepals; corolla petals spreading, longer than the calyx; stamens alternately longer, joined in a ring at the base (in *A. Carambola* the stamens are alternately abortive); anthers somewhat round; style simple; stigma headed; berry large, with five furrows and five cells; seeds attached to the centre of the angles. These trees, particularly the *Carambola*, are met with in every garden in India, where the green fruit are used for tarts, and taste very much like those made of gooseberries. Indeed, the British settlers call the fruit Coromandel gooseberries, but the fruit are called Carambolas by the Portuguese. The following is a reduced figure of the foliage, flowers, and fruit.

A. Carambola.

AVICENNIA (Linnæus). An East-Indian downy-leafed ornamental tree, introduced into this country in 1793. Linnæan class and order, *Didynamia Angiospermia;* natural order, *Myoporinæ*. Generic charaeter: calyx of five equal parts; corolla tube bell-shaped, limb of four spreading parts, segments leaning a little back; stamens protruded; style short; stigmas two, pointed; fruit leathery, two-valved, one-seeded, seeds sprouting.

AVICULA (Lamarck). *Mytilus hirundo* (Linnæus). This genus of shells has very properly been separated by Lamarck from the Linnæan *Mytili*. The form of the shell is scarcely less remarkable than that of the genus *Malleus*, although of a distinct character. The principal part of the shell, containing the body of the animal, is obliquely attached to a long straight transverse base, and somewhat resembles the wings of a bird; the two extremities of the base (which are frequently elongated and of unequal length) may be compared to the tail, so that the shell, when partially expanded, presents the appearance of a bird flying, from which fanciful resemblance the name of the genus, *Avicula*, a little bird, doubtless is derived.

The body of the animal is generally much compressed; the mantle divided through the whole of its circumference, except along the back, and furnished on its unattached edge with a double row of very short tentacular cirrhi; the foot is rather small and channelled, and has a byssus. The mouth is surrounded with fringed lips, in addition to two pair of labial appendages; it possesses a large strong adductor muscle, and two pair of small retractile muscles of the foot. The shell is inequivalve, with a sinus, or singular notch in the left valve, through which the byssus passes; the hinge is linear, with one primary tooth on each valve, beneath the apices, which are oblique, small, and not projecting. The substance of the shell is thin and very fragile in some species, and in others thick and ponderous; the interior pearly in the centre, with a broad black border surrounding it, and the margin terminated in a fringe, formed by the epidermis or foliaceous texture of the exterior; the ligament is more or less external, and contained in a groove, sometimes enlarged towards the summit; it has a very large posterior muscular impression, and a very small anterior one. Lamarck had formed his genus *Meleagrina* from two species of Avicula, but sufficient reason exits to unite them, as the difference of their specific characters is not so strongly defined as to constitute a well-grounded distinction. De Blainville forms two subdivisions, embracing these differences; the first includes the species but slightly oblique, nearly round, nacreous, *very thick*, with the auricles nearly equal, but little salient, and without teeth at the hinge, forming Lamarck's genus *Pintadina*, which he also sometimes calls *Meleagrina*, and Leach's genus *Margarita;* the second contains such species as are of a *thin* texture, oval, oblique, with auricles strongly developed, particularly the superior one, and one tooth on the hinge, as in the *A. macroptera*, here figured in its young state.



A. Macroptera.

Of the two species of the first division, one, the *Avicula margaritifera* (*Mytilus margaritiferus* of Linnæus) produces that costly but modest gem, the highly coveted *pearl.* Some others of this genus produce these isolated deposits of nacreous matter, but none of such beauty and high price; they are only found in the Oriental seas, while most of the others inhabit the South American seas, and one of the number is found in the Mediterranean.

There are fifteen species known in a recent state, and De France enumerates twelve fossil *Avicula*, and three *Pintadinæ*, or a genus nearly allied to them.

This genus is arranged in De Blainville's Malacology, in the third family, *Margaritacea;* order, *Lamellibranchiata;* class, *Acephalophora.*

The *Avicula margaritifera*, or *Mother of Pearl Oyster*, as it is generally called, is so familiar to every one, as affording that beautifully iridescent substance, of which numberless elegant trinkets and other ornaments are formed, that it needs no particular description to most of our readers. It may, however, be proper to state, that its iridescent character depends on the striated surface of the shell; and even when a new surface is given by grinding the shell, the same effect is still produced. We are indebted to Sir D. Brewster for a knowledge of this curious fact, and our artizans, availing themselves of the discovery, have produced the iridescent character of mother of pearl, by simply ruling the surface of polished metal.

AVOCET—*Recurvirostra.* A genus of birds belonging to the order *Grallidæ*, or waders, and much more strictly deserving the name than very many others to which it is applied. Their form, their habits, and their principal haunts, are all so peculiar, that they are a very distinctly marked as well as a very singular and curious genus.

They are birds of considerable size; their bodies are handsomely formed; and their plumage, which is remarkably close and glossy, is generally pure white and black, which increase the apparent intensity of each other by their contrast, and give the birds a very clean appearance. The legs are very long, but they are proportionably strong and well-jointed, and they are so well adjusted to the centre of gravity, that the birds walk in a firm and stately manner, and have great command of themselves. The hind toes are little more than rudimental, but the three front ones are well formed, firm and elastic, so that the bird can rise upon them as springs, when such a movement is necessary. They are half-webbed; but the webs are of a peculiar form; and they are fitted for walking upon soft and oozy surfaces, and not for swimming. In the middle of the interval between every two toes, the web extends barely to half the length of the toes, but it extends from thence in a straight line to each toe as far as the insertion of the claws; so that half the foot has an entire web, joining all the toes, and the other half has a triangular lobe pointed in front, upon both sides of the middle toe, and upon the inner sides of the others. This, as already hinted, is not a swimming structure, because the lobes are most deficient at those places where their effect in swimming would be greatest; and we find that swimming birds which have lobed feet, as, for instance, the grebes, always have the largest lobes toward the points of the toes. But the feet of the avocet answer well for walking upon soft surfaces, and equally well upon surfaces having different degrees of softness. If the place on which it walks is very sludgy, the bird plants the breadth of the foot, which by affording a base of considerable extent, prevents it from sinking; and if the place is hard and firm, or covered with gravel, which last is an unpleasant surface on which to place a foot which must bear on the web, the bird can spring on the comparatively free fulcra of the toes, or there even find points of rest between the nodules of the gravel. Among all the curiously varied structures of the feet of birds, there is not one better adapted to the place in which the creature finds its food than the foot of the avocet. Upon an emergency, too, it can wade to a considerable depth without wetting a feather; for the tarsi are long; and the tibiæ are bare of feathers to nearly half their length. The muscles which move the legs, though not clumsily bulky, are very strong and compact, so that the bird can wade a long time in water or in sludge without being fatigued.

The neck of the avocet is long and flexible, but at the same time strong and well supplied with muscles, so that it can act powerfully in those directions which the habits of the bird require. The head is of moderate size, and compact; and the head, neck, and under parts of the body are feathered in the same manner as water birds, so that they sustain no injury, and indeed are hardly wetted when immersed in water.

The bill is the most singular part. It is very long, flexible, and apparently sentient, at least it is covered with membrane and supplied with vessels, like the bills of snipes, woodcocks, and other birds which are understood to find their food by the touch of that instrument. But the greatest peculiarity of the bill is its form. Most sentient bills are straight or nearly so, and some have a slight inclination upwards; but the bill of the avocet turns upwards with a bold curve, especially toward the tip, the point of the under mandible projecting a little beyond that of the upper. It is in fact such a bill as, judging from the ordinary ones which we are in the habit of seeing upon land birds, or even from the diving bills of swans or the dabbling bills of ducks, we would be very apt to call awkward, and suppose unfit for any useful purpose. But there is no awkwardness or unfitness in nature; and when we meet with an organ of nature's making, we may always be assured that, however awkward it appears to us, it is the very best adapted to that particular purpose or use for which it is intended. We have already had instances of that in the case of the feet of some of the mammalia, especially in those of the sloths [see AI], over which sentimental naturalists have mourned as if nature had botched them in the making; and yet, notwithstanding the wonder of ordinary observers, and the sentimental bemoanings of those half-informed persons, the sloth is a perfect master-piece of mechanical science and skill,—a creature to be wondered at certainly; but to be wondered at for the perfection of its structure and the beauty of its adaptation, and not for its uncommon, and as we on that account think, its ungainly form. The sloth is a singular animal certainly; and it has a singular office to perform in the economy of nature: it must move about, and find its food, and take its repose, in a position the very reverse of that of most of the mammalia. One instance might suffice to teach us that when we meet with what appears to us to be an unwonted or a curious organ, we may look for an unwonted or a curious office which that organ performs; and therefore instead of stopping to wonder at the peculiarity, we should endeavour to make ourselves masters of the lesson to which it points.

The bill of the avocet is so singular, so different from those bills with which we are familiar, that we may be sure that the avocet has some singular habits; and that the sight of the bill in action, or even the knowledge of how it acts, must be far more curious—far more worthy of our rational attention than the mere form itself, peculiar as that certainly is. But the avocet is a shy and retiring bird, as well as a bird of very local and peculiar haunts, so that few can see it at work, and therefore the description of its working becomes the more necessary.

The avocet may be considered as the last bird upon land,—the one which requires but a few very slight alterations in order to launch it upon the waters and make its "home upon the deep." Indeed it cannot be said to be strictly a bird of the land at all, though it sleeps upon the land, and also nestles and rears its young there. But many of the most seaward birds resort to the rocks and banks for repose, and there is no bird which permanently rests upon the waters, nor in fact that builds a floating nest, though some have been alleged to do so from the circumstance of their nests being sometimes floated by casualties. The avocet is not a bird of the water either, it is a bird of the margin, the line where land and water meet: it is one of the few birds, if not the only one, which is exclusively so; and therefore we might look for some peculiarities in it, distinct from both land birds and water birds.

Avocets are fen birds; but, in feeding, they frequent only those parts of the fens which are alternately flooded and left dry by tidal waters, or the small water-courses which discharge their contents immediately into them. Their bills are not adapted for catching any kind of food upon land; neither are they fitted for fishing in the waters. Both land and water are therefore cut off from them, and retained as the preserves of other races. Even the common soft sludgy ground of the marsh, into which the snipes and woodcocks bore for food, is a forbidden pasture to the avocet, as its bill is not adapted for boring. Thus its proper pasture is very much narrowed; and in no country can it be a bird generally distributed over the surface, or even one very abundant in numbers.

But though the pastures of the avocet are thus local and limited, they are very rich, and the food upon which it generally subsists is so situated that it has few rivals. The regular shore-birds, and even the wagtails and some of the other birds which haunt the margin of the waters, pick up the same kind of food when they see it; and many of the swimming-birds dabble for it when the waters are in. But the time that the avocet feeds is when the general surface of the mud is clear of water, and there are only little runs trickling or creeping along in the hollows. The number of living creatures, or of creatures ripening into life, which is contained in the mud, ooze, or light gravel of these, is immense. Worms, and larvæ, and small molluscous and crustaceous animals, are in great plenty; and the myriads of the spawn of fishes in their seasons (and as these vary they extend over a considerable portion of the year), together with the young fry of the same, are beyond all the powers of arithmetic. The greater number of these are imbedded to a small depth, and those that are not get rolled along by the moving sludge, and partially covered by it.

These accumulated matters, which are not seen by birds which feed by the sight, and are not stationary enough for being either bored or dabbled for, are the harvest of the avocet; and the way in which it avails itself of that harvest has some resemblance to reaping, or rather perhaps to mowing. It moves along the run with slow but rather lengthy steps, and scoops the ooze or mud in curves, right and left, as it proceeds. The traces of its scoopings may be seen by any one who happens to come to the place where it has been feeding before the tide rises to efface them; but the bird itself is so shy and wary, that it can be seen by those only who, themselves concealed, have patience to watch for it. In scooping it does not use the bill only, but the whole body; and as the fixed point from which the action is delivered is the foot, it has a wide swing; while, as the exertion is divided among so many acting parts, it can continue it for a long time without fatigue.

The middle line of its operations is the centre of the run or small water course, or hollow in the ooze of the flat beach, as it may be; and it plays or swings upon that as it moves along. In order to have a more perfect understanding of its operations, we shall suppose that it arrives on the wing, from its nest or other resting place, and alights at the lower part of the run. It, of course, prefers proceeding against the stream where there is running water, because the current is always bringing food to it, and also assists it in the capture. It alights in the middle with its head to the stream, and the one foot a little in advance of the other. This position of the feet throws the axis of the body obliquely across the stream, with the head inclined to that side on which the foot is furthest in the rear. It then stretches and depresses the neck, and gives it a twist, so that the extremity of the bill, which is on a level with the ooze, is turned to the other side. The foot furthest in advance is the pivot upon which it is to turn in making the stroke which scoops one curve. Then it slowly advances the rearmost foot, which elevates the hinder part of the body, depresses the fore part, and throws the support on the advanced foot; while, supported upon that, and moved by the lever power of the other as it is brought forward, the axis of the body is brought to cross the run obliquely in the opposite direction to the position at commencement: by this motion the bill is made to scoop a curve from that side of the run where the foot was in the rear at starting to the opposite side; and by the time that that foot has moved the length of its half stretch in front of the other and been planted, the fore part of the body is elevated and the hind part depressed, so that the bill is raised to the surface of the ooze by the action of the body alone. The head and bill are then elevated a little for the purpose of conveying to the gullet the food which the bill may have taken during the scoop. The food is always taken with the part of the bill near the point, or that part which is flat while scooping; and as the curvature of the bill favours the progress of the food towards the gullet, the swallowing is an easy matter, and does not require much elevation of the bill or head. The advanced foot is not brought forward beyond that position at which it is perpendicular, so that the body can swing forward, and be depressed anteriorly by it during the scoop.

In this way the feet are advanced alternately, and the bill at each movement scoops its curve in advance of the moving foot; that is to say, from the side on which the foot is moved to that on which the planted foot is the centre of motion. Of course the scoops are alternately in opposite directions—from left to right when the left foot is moved, and from right to left when the right is moved.

The motion of the bird in feeding is thus quite as unique as the form of its bill. Perhaps there is no bird which feeds so much by the action of its whole body; and there are certainly few, if any, whose motions in feeding are so graceful, or display so much readily seen and easily comprehended science.

And when we consider the bill, and at the same time the manner in which it is used, all our preconceived notions of its awkwardness vanish; and we find that it is not only the best form, but the only form that could answer the purpose. A bird with a bill crooked the other way, as the beaks of rapacious birds are crooked, or a straight one, or even one with a slight curvature upwards, could take up nothing in scooping, and consequently would be of no use to the avocet; so that if the bird had not its specific form, it could not have its present habit. So ready is the recurved bill to take up substances, that, small pebbles are often found in the stomach upon dissection, which the bird takes up along with its food. From the nature of both the food and the stomach these should not be so much required as they are by the gallinæ and other gizzard birds, which live much upon vegetable seeds; but still they *may*, to a certain extent, aid the progress of digestion, in grinding the crusts of shrimps and the shells of mollusca, the smaller species of which must form part of the food of the bird, as they abound in those places where it feeds.

So well is the bill of the avocet formed for being a scoop, that when a mechanic would make an effective one, he in so far imitates the same curve, even though he never heard of the avocet, and knows nothing of its structure or mode of action. At bleaching grounds, and other places where it is required to throw water to a great distance, and with a certain aim, by means of scoops, those scoops always have their trough or containing part, long, narrow, and recurved; and if a straight one of the same dimensions were tried against the recurved one, it would not be found half so effective. The more, too, that the curvature of the scoop resembles that of the avocet's bill, a scoop of the same dimensions and weight lifts the more, and throws it the farther. That is easily explained: the use of the curvature is to resist the centrifugal force of the water, and that force does not act at all against the upper part of the scoop, but it acts powerfully against the part near the point. The curve resists that force till the whole has got the impetus necessary for sending the water to a distance, while the straight scoop begins to spill the instant that the water acquires a momentum. Thus we have a proof of the efficiency of the avocet's bill, in the fact of its being imitated by mechanics without their knowing it.

Avocets are birds of retirement, birds which have their haunts far from the ordinary dwellings of man, and as they are birds which are wholly unprovided with weapons even of defence, they must find their safety in seclusion and concealment. Hence they flit before the progress of improvement. When drainage, and planting, and culture invade the fen, they are the signal for these birds to be gone; and when once they depart, they do not return to the cultivated country. They are birds which, even in proportion to their limited numbers, are probably more rarely seen than most other species.. Marsh birds which do not swim, or run fleetly, or are powerful and much on the wing are, indeed, in general hiders; but perhaps there are few of them so much so as the avocet.

One species, the common avocet (*Recurvirostra avocetta*), is still found in some parts of the fenny shores of England; but it is rare, and appears, of late years, to be rapidly passing away; so that at present it is merely a remnant, and in the course of a short time it may be only a memory. In the season when they are captured, Leadenhall market is perhaps a better place to seek for the fen birds of England than the fens themselves, especially to those who have not much leisure or knowledge of fens, and wish merely for the birds and not for their manners. Now, up to about the year 1820, the avocet was not at all a rare bird in Leadenhall market; that is to say, there might be as many as a dozen of them there in the course of a week, or sometimes a dozen at one time; but now there are not above one or two seen in the course of a year, though the interest which is taken in rare native birds has increased, which has of course augmented the price and increased the inducement to the capture of them. Thus the avocet claims particular attention as one of the family of our native and resident animals which appears to be fast leaving us, and of which the people of the next generation may never see a live British specimen. The details of it are thus more worthy of record than those of other birds which we have in plenty and without apparent decay of numbers. The following figure will give a general notion of its shape and the markings of its colours; and we shall add some of the details in words.

The Avocet.

The length of the avocet is about eighteen inches; but when the legs are stretched backwards, they reach four inches beyond the point of the tail, and of course make the total length four inches more. The tail is short and the closed wings reach rather beyond it; and when they are expanded, their extent from tip to tip is about two feet and a half. The bird cannot thus be said to be one of very powerful wing; but still its capacity for flight is considerable, and from the length, strength, and mode in articulation of the legs, the bird can take the wing with great ease, there being always plenty of air under it. The same strength of the legs assists it in alighting easily. The length of the bill, measured along the curve, is about three inches and a half.

The irides of the eyes are hazel, the naked parts of the feet and legs blue, and all the feathered part of the body either white or black. White is the prevailing colour, and it is beautifully clear, showing very handsome, both on account of the closeness and smoothness of the plumage, and of the black markings, of which the colour is as deep as the white is pure.

The bill, the head as far as to under the eyes, and the nape of the neck are black; but the upper part of the head is less or more relieved with white. There is sometimes a white streak over each eye, and a white spot on the forehead; but in other specimens the spot on the forehead is wanting, and the streaks over the eyes are broken into spots, which are sometimes inconspicuous. All the black markings are liable to vary, not only in different individuals, but probably in the same individuals at different ages. They are always sufficient, however, independently of the form, the bill and the habit (which of themselves are also enough), to distinguish the avocet from every other British bird. Besides those that have been mentioned, the usual black markings are, the bastard wing, the turn of the wing, some of the scapulars and middle coverts, and the quills; all the rest of the upper part generally, and the whole of the under part invariably are white.

From the brightness of its colours, the bold contrast of its markings, the height which it stands on the legs, and its feeding on the dull brownish surface left by the tide, the avocet is a very conspicuous bird, and may be seen at a very considerable distance; but it sees as readily as it is seen, and the distant view is the only one that can be obtained if the observer goes openly upon it. It makes off one knows not very well where, so that one may search long enough without getting another sight.

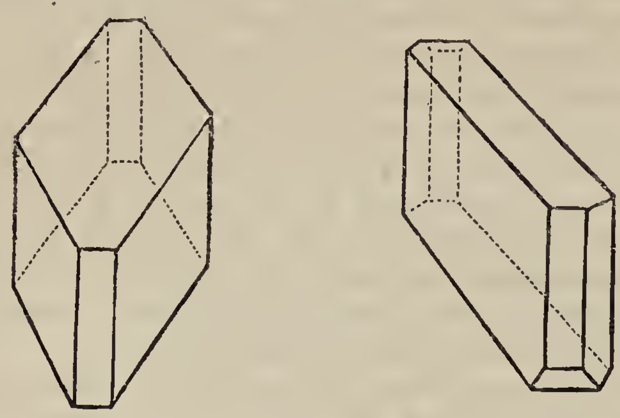
Some of the grallidæ have a shrill and clear whistle, and pipe as loud as a boatswain; but none of them deserve much praise for their "sweet voices." The avocet forms no exception to this, as its cry is harsh and screaming. This is not owing to the bill, uncouth as it seems for a musical instrument; for the bill of birds has very little to do in the sounds which they utter. Their organ of voice is at the lower or pulmonary end of the trachea, and not at the upper or larynx end.

Avocets breed on the borders of the marshes: the eggs are understood to be four, and placed quatrefoil, or in the form of a cross. They are large for the size of the bird, and of an olive brown colour marked with spots. In the breeding season, the birds have much of the shyness which they are said to have in the winter and autumn. They become familiar, and to appearance sportive; but the sport is, like that of the lapwing, a ruse to entice visiters away from the nest. The female especially flies round the head of the visiter, playing in circles, and uttering an incessant but not apparently angry cry of "quheet, quheet," and she receives him, and also takes leave of him, at a considerable distance from that place which she seems anxious he should not visit. The nests are now become, of course, as rare as the birds, and it is as difficult to procure an avocet's egg as to procure an avocet. They and some others of the resident marsh birds appear to be passing away faster than there is any apparent reason for; for in the years that have been mentioned there has really been no alteration, at least no artificial alteration in the fens, that appears at all calculated to reduce their numbers to one in the hundred, which, from their appearance in the market, seems to be about the ratio. The circumstances which influence the numbers of wild animals are, however, but imperfectly known.

Avocets are more numerous in some other countries than they are in England; and there are several foreign species differing from the common one in their colours, though their habits appear to be so much the same as to render details unnecessary. An American species is described as having a reddish or purplish mantle on the lower part of the neck, and there is one mentioned in India which is all white except the wings. The variations which are found in the markings of even the few that are to be found in this country, are sufficient to make us cautious in founding species upon mere differences of colour.

AWLWORT. Called by Linnæus *Subularia*, a tetrandrious plant, found in most of our lakes.

AXINITE. This mineral derives its title from the peculiar shape of its crystals, which somewhat resemble an axe. When any marked peculiarity of this kind occurs, an accurate delineation of the crystal is preferable to an engraving of the mineral in mass. In the present case two of the crystals are represented in the accompanying figures.



The most common colour of this mineral is clove-brown, of various degrees of intensity; from which it passes on the one side into blue, on the other into pearl-grey, ash-grey, and greyish-black. In some few instances it is found of a green colour.

Axinite occurs in rocks of gneiss, mica-slate, clay-slate, and hornblende. The massive varieties are met with in beds, and crystallised in veins. In the Saxon metalliferous mountains, where it occurs in beds, it is associated with massive calcareous-spar, common chlorite, magnetic-pyrites, iron-pyrites, arsenical pyrites, copper-pyrites, blende, and probably also with actinolite and hornblende. At Kongsberg, in Norway, it is grouped along with native silver, galena, slaty glance-coal, and calcareous-spar. In the Felberthal, in Salzburg, it occurs in mica slate; and in the Hartz, along with quartz and asbestos; at Arendal, in Norway, along with calcareous-spar, common actinolite, common iron-pyrites, felspar, epidote, and sphene. The axinite from Dauphiny, Savoy, and several other places, occurs in small veins that traverse gneiss, in which it is generally the uppermost mineral.

The peculiar crystalline character of axinite was originally described by Romé de Lisle, but he arranged it with schorl; and it was Werner who first established it as a distinct species.

AXINURUS. A genus of spinous-finned fishes, belonging to the lancet-fish family, or those which have spines on the sides of the tail, by means of which they can inflict wounds. Only one species is mentioned, *Axinurus thyneroides*, and very little is known respecting it. It is a native of the eastern seas, and has been found only on the coast of New Guinea, where, like the rest of the family, it frequents those places which abound in sea-weeds. But the structure of its teeth, which are small, and stand apart from each other, points out that it does not, like some of the other genera of the family, feed either upon sea-weed or upon animals that have hard crusts or shells. Its form, too, indicates more of a swimmer, and of discursiveness or activity in the capture of its food. Its body is considerably elongated, and its mouth is small, without any projecting snout, and the teeth, as has been said, are slender and wide apart. It has four rays on the gill-flap, and three soft ones on each of the ventral fins. Each side of the tail is armed with a powerful four-cornered spine, very strong, hard and sharp in the edges, and capable of inflicting very severe wounds. These spines, as in all the family, are, however, weapons of defence, not of offence. It has the long intestines of the rest of the family, and therefore, though its teeth are not well adapted for cutting, it may live upon the more succulent species of sea-weed.

AXOLOTL—*Proteus Mexicanus.* A singular species (if not distinct genus) of Batrachian reptile, found in some of the shallow lakes and pools in the interior of Mexico, and especially on the borders of the great lake near the city. It is about eight or ten inches long, of a grey colour, spotted with black, the hinder part having considerable resemblance to a fish, and being furnished with a fin. It has four legs, however, the anterior ones furnished with four toes each, and the posterior with five. Its breathing apparatus consists of three gills in the form of tufts; and the mouth is abundantly supplied with small teeth, very similar to the teeth of fishes in their form and arrangement.

Too little is known of its progressive history, the mode of its production, and the changes which it undergoes, for enabling a positive decision to be made whether it should belong to the genus *Proteus* or not; and therefore Cuvier very properly places it by itself, and marks it as doubtful. It is very plain, however, that Shaw was decidedly wrong in classing it with the sirens, as *Siren pisciformis:* the sirens have only two feet, while it has four, and there are other structural differences. If the young are really without feet, and blind, it may perhaps be admitted as a species of proteus; but the European proteus is very differently furnished with toes, having three on the fore feet, and two on the hind.

AYE-AYE — *Cheiromys Madagascariensis* —the handed rat of Madagascar. A very singular animal, classed by Cuvier among the *Rodentia,* or gnawing animals, as intermediate between the squirrels and rats. From the structure of its teeth, it certainly requires to be so classed; but in the form of its body and the structure of its extremities, it resembles more the quadrumana, or handed animals. But the form of the body of an animal, or the structure of the limbs and their terminations, are much less important characters than the teeth, as the latter determine the food of the animal, while the former point out only the general means by which the food is arrived at.

The above figure of this singular animal will, in part, save the necessity of verbal description.

The size of the aye-aye is about the same as that of a hare; the covering of the body is a mixture of brown and yellow; the ears, which are large, are nearly naked; and the long tail is covered with coarse black hair: the tail is not prehensile. The outline of the head has not the arched or rounded form which is common to all, or nearly all, the true *rodentia*, which are ascertained to gnaw vegetable substances, but more resembles that of some of the quadrumana; the teeth are, however, truly rodent in their structure: the incisors are very large, and curve outwards in both jaws; and on their front edges they are much more deeply furrowed than those of the squirrels. They are two in each jaw, which is the normal, and indeed the constant number in the rodentia. Four cutting teeth in each jaw is the normal number in the quadrumana, though some have as many as six in the under jaw, and some are described as having only two in the one, but a greater number in the other. The subjects from which those accounts are taken are, however, in some instances, only mutilated fragments, so that descriptions founded on them are not very satisfactory. All the quadrumana, too, have canine teeth, which are wholly wanting in the aye-aye, and their grinders are more numerous. Of these, the aye-aye has four in each side of the upper jaw, and three in the under, small in size, and separated from the cutting teeth by wide intervals. The quadrumana also have pectoral mammæ; but the mammæ of the aye-aye, which, like these, are, only two in number, are in the groin. Indeed, all the characters which are usually considered as being most important in the formation of a natural or structural classification, are similar to those of the rodentia.

Still there are some doubts as to the habits of the animal. Like the *galagos* and *tarsius*, which perhaps deviate more from what may be considered the type of the order, and which in structure they resemble the most, the animals of the genus under consideration are nocturnal; and they are said to live upon insects and larvæ, which they pick out of the crevices of the bark with their long and slender fingers. However that *may* be, the form of their fingers is certainly not the best adapted for such a purpose, inasmuch as an insect cannot easily be taken by means of a single finger terminated by a claw, however long and slender it may be. The teeth, too, are very unlike those of any animals which are known to feed exclusively or chiefly upon insects; and the nocturnal habits of the animals, if not adverse to the fact of picking insects and larvæ out of the crevices of the bark, are, at all events, not very favourable to the observation of it. No doubt many of the rodentia are insectivorous, and contrive to capture insect prey in the dark (the common mouse is a great devourer of cock-roaches), but they do not pick them out of small crevices. In confinement, the aye-aye has been fed wholly upon vegetable matter, which it ate very readily, using its hands like a squirrel; or rather its long fingers, as the Chinese do their "chop-sticks."

The aye-aye is described as spending the day in holes of the ground; one would suppose natural ones, because the paws are very unlike those of ordinary burrowing animals; but the same or similar purposes are, in the animal kingdom, so often accomplished by organs apparently very different from each other, that this animal may dig its own burrows.

The general character is, however, that of a climber, though a less expert climber than many other animals because of the shortness of the fore-legs; these are considerably shorter and also more feeble than the hind ones, and the length and slenderness of the fingers makes them look more feeble than they are in reality. All the fingers on these paws (or hands) are very long and slender, especially the second ones; and the claws upon them are long, considerably crooked, and at their bases nearly as thick as the fingers. The thumb on these is articulated near the wrist, and the point of it does not reach beyond the first joint of the fore-finger; but it acts very slightly, if at all, in opposition to the fingers; the fact is, that the hands, like the animal itself, are rather puzzles, as there is not any similar organs with which they can be very fairly compared. From the shortness and feebleness of the arms, and the spider-like structure of the hands, they are neither efficient for walking nor for reaching long distances from branch to branch in climbing; and the lengths of the fingers are so unequal, and the nails so long, that the fingers do not appear very capable of being used in any way but singly.

The hind feet are much more robust, and formed as if they were the principal organs of locomotion; the soles are long, and they plant them fairly upon the ground, and do not turn on the side, like the feet of many animals that live chiefly in trees. The toes on them are long and slender, but not nearly so much so as those on the anterior extremities, and the nails, though sharp and considerably crooked, are much smaller. The thumbs on the hind feet are articulated far back; they are rather short, reaching only as far as the division of the fingers; but they act in opposition to these, so that the foot is both a walking and a prehensile instrument; the hind leg and thigh are as stout and muscular as the fore ones are slender.

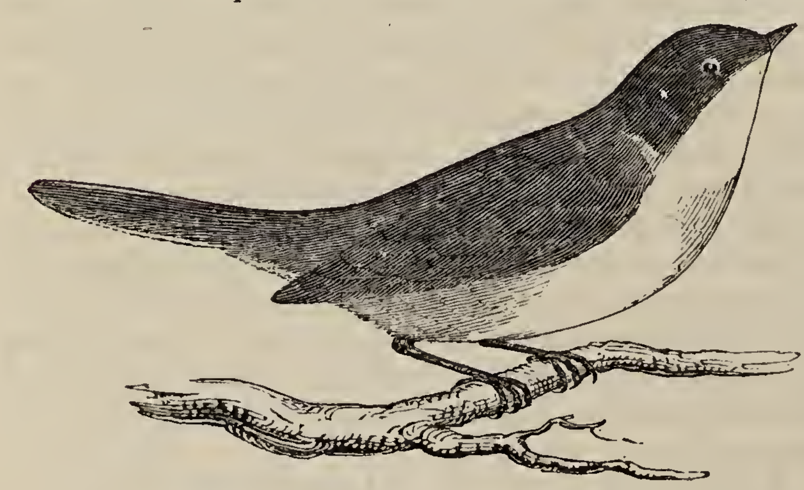
The whole animal indeed is peculiar, almost to the extent of being an anomaly. It is certainly made a separate genus with much propriety; and it can hardly be said to come into any of the natural families, and not very satisfactorily into any of the orders, as at present constituted. If the teeth are to be taken as the basis, and that they are the most certain basis there is no question, the animal clearly and decidedly belongs to the rodentia; because the coincidence with those species which may be regarded as typical of the order are perfect. Upon this point Cuvier appears not to have the slightest doubt or hesitation, and his knowledge of the structure of animals, and discrimination in the use of it for the purposes of arrangement, were of so very superior a description that, except upon some minor points where he was not well informed as to the facts, opposition to what he has deliberately laid down, betrays as much of rashness as of any thing else. If, on the other hand, we depart from the principle of the teeth, and go to the general structure of the animal, we are left in doubt and perplexity. It has analogy to several others; but it has well-established affinity to none; and even the analogies are imperfect, and far from close, even as far as they go. There is not, in any respect, identity between it and any other handed animal. It stands alone, and it wants to be more intimately studied.

AYENIA (Linnæus). A genus of plants containing two species, natives of Jamaica; one is an under shrub, the other a biennial herb. Linnæan class and order, *Pentandria Monogynia;* natural order, *Malvaceæ*. Generic character: calyx five-cleft; corolla petals clawed, the tops bearing brown, star-like glands; urceolus, five-toothed, and bearing the stamens; anthers starry, like the petals; stigma five-lobed; capsules five-united, five-berried; berry one-seeded.

AZALEA (Linnæus). An extensive genus of beautiful flowering shrubs, natives of China, Turkey, and North America. Linnæan class and order, *Pentandria Monogynia;* natural order, *Rhodoraceæ*. Generic character: calyx of five teeth; corolla funnel-shaped, limb in five divisions; stamens inserted in the receptacle, unequal; capsule from three to five-celled, valves of the dissepiments formal. Of this fine family of shrubs there are twelve species, and from these have been obtained no less than eighty-three varieties! to which daily additions are making. The new ones introduced from China within these last forty years are amongst the most splendid plants in our collections: which, together with the old American species, are, in our borders, the chief of the high coloured ornaments.

AZAROLE. A large fruited species of hawthorn, viz., the *Cratægus azarolus* of botanists. Every part of the plant, especially the leaves, are of a more ample form than the common whitethorn, and the fruit being nearly an inch in diameter, are cultivated in Italy for the use of the dessert. The fruit arrive at a fair size in England, but are too insipid for English palates.

BABILLARD, white breasted, and babbling fauvette, or lesser whitethroat (*Curruca garrula*, Brisson). Provincial, *Nettle-creeper*. A small frugivorous warbler, common in the southern parts of Britain, and in many of the more temperate of Europe and Asia. It is a migratory species, arriving in the neighbourhood of London about the end of April, and departing, for the most part, towards the latter end of September, though a few stragglers are sometimes observed till late in the following month. The bill is of a dusky hue, much resembling in form that of the blackcap, but rather smaller and more slender. The irides, in the younger individuals, are dark hazel, with a tinge of reddish; but in the course of three or four years become gradually pure white. The upper part of the head is of a fine ash colour, darkest about the ear-coverts, where it contrasts with the snowy whiteness of the throat: all the other parts above cinereous brown: quills and tail dusky, edged with ash colour; the exterior feather of the latter whitish almost to the base; the outer web quite white. The whole under parts



Babillard.

are white, purest on the throat and belly, and inclining to silvery on the breast and flanks; which last, in the older males, are often tinged with a blush colour. Legs and feet dusky lead colour.

This active little bird is found chiefly about orchards and gardens, and tall hedges, especially of elm and hawthorn, where it may readily be distinguished in the spring and summer by its continual reiteration of a monotonous and loud shrill note, resembling the sound *jee*, or *ghui*, repeated several times in quick succession. It has also a soft and pleasing continuous warble, not very much unlike that of the blackcap (*C. atricapilla*), only more faint and weak, and easily distinguishable by the frequent recurrence of a note like *sip-sip-sip*. As it proceeds, it gradually raises its voice, and mostly ends with the tiresome and monotonous note first mentioned, which is analogous to the clear and lively whistle with which its congener, the blackcap, most frequently concludes. This species is never observed to mount warbling into the air, as is the habit of another near congener, the whitethroat.

The Babillard has usually been represented to pass the whole of its time among low underwood, whence specimens of it could only be obtained with difficulty, and by patient watching. This is, however, quite at variance with our observation, for we have always noticed it chiefly to inhabit trees, and have heard it repeatedly, and shot it, from the tops of the very highest elms. Moreover, from its perpetual activity, when searching the leafy branches for food, it is more frequently visible, and is consequently, perhaps, even easier to procure than any of its British congeners. Unlike the whitethroat (*C. cinerea*), this species is nowhere to be found but where there are trees.

The nest is usually built in low bushes, though sometimes as much as nine or ten feet from the ground, and not unfrequently among nettles, or other coarse herbage (whence the term *nettle-creeper**, its common provincial appellation in the south of England). It is a tolerably compact structure, though in appearance flimsy and frail, being composed of the dry fragile stems of catch-weed, or cleavers (*Galium aparine*), neatly put together, though so scantily that the light may everywhere be seen through it, and invariably lined with small fibrous roots, sometimes with the addition of a little horse-hair. The eggs are four or five in number, of a dull white, speckled with brown and ash colour, chiefly at the larger end, where the spots often form a zone. They are rather smaller than those of the whitethroat, and the spots are larger, having more the appearance of blotches.

The food of this species consists of small insects and caterpillars, together with the various garden fruits, being particularly fond of cherries, raspberries, and currants. It is rarely heard to sing from the time these are about, and soon after commences its autumnal change of plumage; both old and young, however, being still easily recognisable, at this period of their garden depredations, by their constant repetition of a note sounding like the tapping together of two pebbles. This note is also uttered, but more loudly, by the blackcap, and with slight modifications by all the other members of the genus.

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* In most works on the birds of Britain, this name is applied to the common whitethroat, but erroneously. The two species are often confounded by common observers, as they have been by naturalists; but whenever a distinction is made, we have always found one to be designated *whitethroat*, and the other *nettle-creeper*.

In confinement, the Babillard is a very quarrelsome and domineering little bird, being in general, on this account, quite unfit for the aviary, as it will attack, and completely persecute, birds even double or treble its own size and apparent force. It is a more active species, and quicker in its movements, than any of its British congeners; and it often climbs along the wires, a habit not observed in the rest. It also frequently throws itself over backwards when in a large cage, performing somersets in the air, often for seven or eight times in succession. It is a lively and healthy creature in captivity, and soon becomes extremely familiar and tame.

The female resembles the male in plumage, and the young only differ in the crown of the head being of the same colour with the back.

BABOON. The popular name of a subdivision of the quadrumana, or four-handed animals, extending to more than one genus, and including animals of which both the characters and the habits vary considerably, and some to which the name does not very well apply. The names, ape, baboon, and monkey, have been sometimes all applied to the same species, different species have been called by the same name, and the same species have been called by different names, so that it seems almost impossible to get rid of the confusion in any other way than by a general muster of all the species, and naming them anew. It is doubtful if even that would be sufficient, and it is certain that, with only a single specimen of each, it would not. There appear to be considerable varieties arising from age, haunt, and other circumstances; and these are not confined to mere differences of colour, to which most species of animals are more or less subject; but they extend to size; and, in so far as difference of haunt is accompanied by a difference of food, they extend also to disposition.

Taking the general character from those species which may be regarded as the most typical of the creature, that is from those which least resemble any of the other groups of quadrumana, for that is all which is in general meant by being typical, we might infer that there would be more variety and more disposition to variety in the baboons than in the apes, or perhaps even in the monkeys, if restricted either to those of the eastern continent, or those of the western. The apes, properly so called, are so very local, that there is no scope for breaking them into climatal varieties, and though, as might be expected, there appears to be differences between the chimpansee of Asia and of Africa, yet in each country, that, the most erratic of all the true apes, appears to be constant to its type.

The true apes are, in general, such bad walkers, that their range is confined to the forest, and their food to what they find upon the trees, they are thus as much like each other in habits as human beings which inhabit the same city and live in the same manner, or rather like deer in the same park, or sheep on the same down; and it is well known that, under these circumstances, instead of there being any disposition to run into varieties, there is a disposition the other way.

It is not so with the baboons properly so called. They no doubt are climbers, as all four-handed animals are, climbing being the sole, or at least the chief use of that form of organisation. But they are not exclusively made for climbing; their anterior and posterior extremities have no very marked disparity in length; the soles of their hind feet apply to the ground; their limbs, though clumsy as organs of progressive motion compared with those of running animals, have not the wriggling flexibility of those of the climbers; and they can accordingly walk and run with considerable velocity. Thus, though the baboons are, to a certain extent, forest animals, they are not exclusively so. They are so formed that they could live habitually in the forest if there were no other pastures, or in other pastures, if there were no forest.

Now, it agrees with analogy, and also with the facts, that when any production of nature, whether animal or vegetable, has this compound nature, it can, either by art or by natural circumstances, be so *worked* upon one part of the compound, as to take its leading character from that, and in part lose the other; and this holds whether the circumstance by means of which it is worked be food, climate, or any other. We find proofs of this in man himself, and in all that man cultivates, and we see so many additional instances of its operation in wild nature, that we can have no doubt of its being a very general and invariable law of nature, the operation of which must, in all cases where we have difficulty about species, except where the difficulty is of our own making, be one of the chief causes of that difficulty. That this is at least one of the chief causes of that uncertainty which obscures part of the history of the baboons, there can be no doubt.

Indeed, the characters upon which we proceed in the formation of groups and genera, are not unfrequently the causes of more difficulty to us than if we had left classification altogether alone. They are often mere differences of form in parts of the uses of which we know nothing; and as such, it is impossible to connect them with any thing useful—any thing which can lead to a knowledge of the disposition or habits of that of which they are taken as the characters. That this has been the case with the quadrumana of the old continent, there is little doubt: the foundations of the grouping have been the presence or the absence of cheek pouches or tails; and as we know not very well the uses either of the one or the other (none of the species on the old continent having prehensile tails), the conclusions which we draw cannot contain more information than the premises from which we draw them. If the question were between having no tail and having a very large one, which we might suppose effective in balancing the body, as between the apes proper and the monkeys, there might be at least a show of reasoning set up; but when it is between having no tail and having next to none, as is the case with some of the animals classed as baboons, there is but little scope for philosophy in it.

But there are other circumstances in the structure of the baboons which tend to show that they have a greater range or diversity of habit than the apes: their mouths are more of prehensile instruments; and the nostrils are carried forward near to the muzzle, as if for the purpose of guiding the mouth in the selection of that which it seizes. They have more of both the structure and the expression of animals which are, in part at least, carnivorous; and when both structure and expression point to any habit, that habit is never wanting if there be opportunity for its exercise.

These observations will, in part at least, explain why there is not that clearness of general definition about the baboons, which we find in some of the allied sections, and also why we have not been able to give some account of them as indicating the general natural character of some locality or district. The section contains (part of) several genera differing considerably in their localities and habits; these demand some new arrangement; but as that arrangement falls not within the province of a popular work, we purpose to follow the arrangement of Cuvier, noticing the general characters of each sub-division and giving a slight enumeration of at least the more remarkable and better known species.

In their form and expression, the baboons, in all their varieties, are the least handsome, or perhaps it is more accurate to say, the most positively ugly of all the mammalia. Though the form of the head approaches that of the beasts of prey, there still remains as much of resemblance to man as forms a very ugly caricature; and though the expression is ferocious, it is not the kind of ferocity which we find in carnivorous animals. The most savage expression which we find among those animals whose habit it is to kill prey, sits, as one would say, naturally upon them, is in keeping and congruity with the whole of their character and habits; and when we admit the habit, which is but another name for the use or purpose of the animal in the economy of nature, we must also admit that the expression is natural, and that, were it more mild, we should regard it as an expression of deceit, as which it would be more offensive than that which is in accordance with nature. But the general structure of the baboons does not impress us with the notion of a carnivorous animal, or one which habitually kills for its food. It is ferocity without a purpose, analogous to that of a man who is always offended and snarling without cause; and who, though far from the most dangerous, is certainly the most disagreeable of the whole race. We admire power, even destructive power, when the object of it is consistent with the expression; and if the lion and the eagle had the expression of the lamb and the pigeon, they would be in truth ugly animals. The same is the feeling that we have of the converse, as instanced in the baboons. Their expression is mischievous; but it indicates mischief in which there is no meaning, because there appears to be no necessity for it in the economy of the animals. They have it; yet it is not "their vocation," not in any way essential to the finding of their food, or the performance of any office which appears to be necessary in their economy. Offensive as this expression is, it is perhaps the one which, more than any thing else, led to the ancient comparison of the quadrumana with man. The species which must have been best known to the Greeks and Romans, perhaps the only one with which they were familiar, and certainly the one which was dissected by Galen, and from which he inferred, by comparison, many points in human anatomy, was the magot or Barbary ape; which Cuvier classes with the baboons, and which, though it has not all the characters of the more typical species, has yet much of the ferociously snarling expression.

Those who seek for something correspondent in man and the quadrumana, certainly find it more in this expression of malignant and unmeaning ill-nature than in any thing else; and thus the most repulsive of the baboons has really more of man in him than the chimpansee or the orang-utan; for, except in the baboons and in bad men, we may seek nature in vain for the expression of purposeless malignity. And the parallel may be extended somewhat further. The manners of the baboon are as offensive as his expression is ferocious; and, as is the case with the man of ferocious expression, the offensive manners appear to have as little necessary foundation in nature as the disagreeable expression. The baboon is thus one of the most anomalous of animals. He does not appear fitted for any particular region or place; and he has an expression and habit which we find nothing in his circumstances or mode of life, which, according to the experience which we have of other animals, should call forth or justify that expression or those actions.

But we are not to suppose that this correspondence between certain parts of the expression and conduct of the baboons and those of human beings of a peculiar temperament have any analogy in nature, any more than there is an analogy of nature between the forms of apes and the form of man. That which we find in the baboon is not depravity or corruption arising from bad conduct, bad company, or any of the demoralising causes which act upon man. It is part of the nature of the animal, and must be in some way necessary to the existence and comfort of that animal; and, offensive as from our ignorance it appears to us, there is not the least doubt that, if we could discover its cause, we should find that it is as necessary and perfect as any thing else we meet with in nature. In their native localities the baboons must be exposed to the attacks of the medium-sized cats, which are powerful animals, much swifter on the ground than the baboons, and not much less expert in climbing; for though the baboons can get along very nimbly among the stiff branches, they cannot leap from tree to tree, or swing themselves on the smaller twigs to which their feline foes dare not pursue them. That their fierceness is meant as a protection against their foes has not been fully established, because the attacks of these larger cats upon their prey are not events of every-day observation; but the probability is that it answers some such purpose. We shall now notice the subdivisions of the baboons.

The first subdivision, and the one which has the baboon character and ferocity the least marked, is that to which the name of Macaco (*Macacus*) is applied, though different systematists have divided it differently into genera, but all the species do not get the popular name of baboons, or indeed when the common principles of nomenclature deserve it.

The animals of this subdivision, though very much circumscribed in latitude, have a very remarkable range of longitude, extending from the western parts of northern Africa, or even from Europe (for one of the species is found in the south of Spain, at least on the top of the rock of Gibraltar, and is the only quadrumanous animal found in a wild state in Europe) to China, and the extreme eastern isles of Asia. They are not continuous, however, in all that range, because if a line is laid across the map it will be found that much of what it falls upon is desert, or at least destitute of trees, and as such not adapted for these animals, and that the parts so adapted are but a few points. The species too, at least those which can with any propriety be considered baboons, are not many; and lying far apart in their localities, they differ much in their appearance. They are not so equatorial in their locality as the apes, or the more formidable and ferocious baboons; and it does not appear that they are found in the southern hemisphere, or even within several degrees of the equator.

In their general characters they are intermediate between the apes and the baboons: the muzzle is much more produced than in the apes, but the cranial part of the head is greater in proportion to the bones of the face than in the baboons. The nostrils, too, are not so terminal on the snout, but leave a sort of projecting upper lip; the canine teeth are not quite so formidable, and the whole mouth has a less snarling and cur-like expression. The muzzle is elongated and blunt, the facial angle from forty-five to forty degrees, the eyebrows prominent, the lower part of the forehead arched, the upper part sloping very much backwards, the tail in all the species rather short, and in some a mere tubercle. We shall now, very briefly, notice the leading species in this subdivision.

1. The Magot, or Barbary Ape (*Macacus Sylvanus*). This species, as having been in all ages the most accessible to Europeans, has been the largest and the most familiarly known of all the four-handed race. The second of its popular names indicates its principal locality—northern Africa, the forests on the slopes of the mountains of Atlas, and their lateral spurs, though it is also found in considerable numbers on the rock of Gibraltar, the most elevated point of which rises to the height of 1439 feet above the level of the sea, and has the slopes in many places covered with a profusion of plants both of the south of Europe and of northern Africa. The magot appears to thrive as well and attain as large a size there as on the south side of the Strait. Besides this European colony, it does not appear that the species is found any where out of Africa, or in Africa to the south or east of the desert.

A general idea of the appearance of the animal when in a state of indolent and apparently sulky repose may be formed from Landseer's characteristic sketch, at the bottom of the plate "Baboons." The colour of the upper part, including that of the outsides of the limbs, is clear yellowish brown, rather deeper on the upper part of the head and on the borders of the cheeks. The colour on the under part is dull yellowish-white; and the naked skin, the face, ears, paws, and callosities on the hinder extremities are dull flesh-colour. The fingers are of moderate length, and strongly made; the muzzle, which is broad and flat, elongates as the animal gets old. The tail is a mere tubercular rudiment, altogether unconnected with the bones.

It is not a very large animal, the male not exceeding two feet and a half in length, and the female being smaller. The adult male has the canine teeth large, and is a vicious and rather dangerous animal. But the formidable canine teeth are no indication of a carnivorous habit, as they are very little larger than the other teeth in the female; and in the male, as in the wild boar and some other feeders upon vegetables, they appear to be for mere defence, rather than for predatory purposes.

This species has, from time immemorial, been the showman's "ape" in Europe, and while young it may be *educated* (by blows) into some obedience, and the performance of a few tricks. But as it gets towards maturity, it becomes morose and sullen, and (the male especially) mischievous and refractory, till his strength and spirit both fail under the hateful restraint of confinement, which is obviously very repugnant to the nature of the animal. So contrary, indeed, is confinement to their nature, that their health soon gives way under it, and they perish, not of the effects of climate, as is the case with the species which naturally inhabit more toward the equator, but from the constant irritation of constraint and confinement.

In the freedom of their native wilds and forests they are represented as being very different. Social, active, and energetic; bold and courageous in the defence of each other and of their young; and so strong is the latter propensity, that confined ones, if in tolerable health, whether males or females, are said to adopt, and fondle with paternal attention, any small animals that may be put into the same cages with them. Several fables of the ancients are founded upon the attachment of this species to their young; and, among the rest, the very instructive one of the favourite which was carried in the arms being killed by the fall of the mother, while the neglected one, which rode on the back, escaped without injury.

When in their native forests, they carry on their defensive operations, in part at least, as all the race do, by the noise of their war cry; and it is a curious fact in the history of predatory animals, that many, even of the formidable ones, are sooner driven off by noise than by any other means.

The magot is not a very handsome or a very interesting animal; but it acquires a sort of interest from the length of time that it has been known, and the consequent mention of it which is made in history, both authentic and fabulous. Its general association, in the systems, has been with the apes; its proper natural association seems to be with the Asiatic monkeys (for where tails are not prehensile, the presence or absence of a tail is a secondary consideration); and its being included among the baboons by Cuvier, entitles it to a place in this article.

2. The Wanderoo (*Macacus Silenus*). This species, which has not been so long or so familiarly known in the western world as the former, has been allowed to retain its proper vulgar appellation of a monkey, though it is just as much entitled to be called a baboon as the magot. It is a native of India, of Ceylon, and probably of some others of the eastern islands; and in some of its localities it has, by the gravity of its deportment, procured for itself a name for wisdom far above that of the smaller and more useless and noisy monkeys.

Wanderoo.

The external characters of this species are so marked and peculiar, that they cannot easily be mistaken. The face has not much in the way of beauty to recommend it, being flesh coloured below the eyes and black toward the muzzle, which is prolonged as in the former species: but the way in which the visage is decked out with hair gives it a singular, if not a sage appearance. The hair on the upper part of the head, from a little above the eyes, is of a deep black colour, which contrasts well with the flesh tint of the naked part of the face there, while the lower and black part of the face is surrounded by a produced ruff varying in colour from ash-grey to nearly white. The callosities on the hinder extremities are, as in the former species, of a flesh colour, and they, as well as the cheek pouches, are large for the size of the animal. The hair on the upper part is black, and that on the under part ash-grey or white. The body is about the same length as that of the magot, the female being, as in that species, of smaller size and less irritable disposition than the male. The tail is a regular continuation of the vertebræ, about half the length of the body, and, when perfect, ending in a brush or tuft of long hair, from which the animal has been called the "lion-tailed monkey." The character of this species, especially that of the adult male, is, like all others of the subdivision, a little suspicious; but it is said to be rather more playful than the magot, and not quite so much given to mischief.

3. The Pig-tailed Baboon, or Maimon (*Macacus nemistrina*). There is some confusion about this species, arising from another of the same genus having been called by the same popular name, which shows the inconvenience of naming an animal from the form of its tail, when that tail happens to be a useless organ. The other (*Rhesus*) is generally styled the pig-tailed monkey, this the pig-tailed baboon. Both species are inhabitants of the south-east of Asia. A figure of the present species in an erect posture, is given at the top of the plate "Baboons." Animals of this species are apt to get apparently deformed, by accumulations of pendulous fat on the throat, the abdomen, and other parts of their bodies. They are not very interesting animals, as they are rather untractable, but that seems to arise more from dulness than from vice.

4. The Black Baboon, or Black Ape (*Macacus niger*). This is a species of considerably more interest than the former, on account of its being more rare, more recent as an authenticated addition to zoology, and a more interesting animal in its manners, although by no means a handsome one in its appearance. A figure of it as "the black baboon," is given at the top of the plate "Baboons;" but as there is another "black baboon," belonging to the subdivision, that has more of the baboon character, it is necessary to attend to the circumstance that this one is black all over, while the other is yellowish, or straw-coloured on the under part.

The native locality of this species is not perfectly ascertained. The specimen from which Cuvier mentions it, but which appears to have been too imperfect for enabling him to ascertain its proper place in the system, he describes as having been brought from the Philippine islands; and as such it must inhabit more easterly than any of the species which we have already noticed. Three specimens which have successively been in England in the living state, have led to a more accurate knowledge and appropriate classification of the animal; but as it is not exactly known whence any of those were obtained, the locality remains as undetermined as ever. When there has been any tradition, that has indeed implied that they came from "the South Sea;" but as the South Sea is a common name for the whole Pacific Ocean, the expression is somewhat vague. It is known, however, that no quadrumanous animal inhabits Australia, New Zealand, or any of the remote groups of islands which are scattered over that wide ocean, so that the probability is that the locality may not have been far from that where the mutilated skin from which the French formed their description was obtained; and that they were from some place rather northward, such as the Philippines, is probable, because they appear to bear the climate better than those species which come from near the equator. The first specimen which was known in England was in the Tower menagerie, from which the remains found their way to the British Museum. This specimen was described and figured by Mr. Gray; but the name and place in the system, which Cuvier had founded upon Desmarest's description of the mutilated skin, were retained. Another live specimen was some time ago exhibited at Exeter 'Change, the animals at which, on their removal, formed the basis of the collection at the Surrey zoological gardens; but the native habitat of this one appears to have been no better known than that of the former; and it does not appear that from the inspection of it, any one attempted to correct the natural history of the animal. A third specimen came into the possession of the zoological society, though without any more information as to where it was obtained than the others. In the early days of that society, and while the managers were attempting, most laudably no doubt, to draw toward it such a share of public attention as should ensure sufficient profit as a mercantile speculation, to defray the current expense and pay for additions and improvements, it was of course desirable to get hold of all rare animals. But ignorance of the native locality of an animal, leaves a sad blank in its natural history, and reduces it much to the level of a common museum specimen, which does very well for being wondered at when seen, but comes one knows not where, and is good for one knows not what. So that, now when the zoological society is fully established, and enjoying high patronage, it were much to be desired that no animal should now be admitted into the collection there without an authenticated record of its previous history, or, at all events, a note of "the name of its parish." That would take off every appearance of mere raree-show-ism; and render true to nature in all its parts, a zoological collection which must very soon be by far the foremost in the world. The number of British zoologists spread over the face of the globe, as well as the number of corresponding members which the society now have, must give precision and geographical truth to many of the additions now to be made, and thus there will be less need for having recourse to animals of unknown localities which may be occasionally for sale. The captains of ships, too, if they found that the geography of animals were a *sine qua non* with the best customers in the purchase of them, naturally would, as they in general easily could, fill up that blank in their history. The old showmen spoiled that part of the business; for if they could find an animal which was, or *could be made*, novel enough in its appearance, they soon gave it "a local habitation and a name," with as much poetical licence as the votaries of Parnassus. It is owing to these circumstances that we are still ignorant of the native locality of an animal, whose history it would be desirable to clear up in that point as well as in the others.

As the native region of this species is not known, it is needless to add, that we are in total ignorance of its habits in a state of nature. This is the more to be regretted that, while it has all the essential characters of a true *macaco*, it has also more of the external appearances of the true baboons than any other of the subdivision to which, from its essential characters, it belongs. It would thus be highly desirable to know something of its disposition and habits in a state of nature; for though in confinement it shows more activity, and perhaps a greater love of mischief than the other *macacos*, these displays are not sufficient for forming such an estimate of its character as to show whether that is in any way modified by its baboon-like appearance. The most striking of these is the fleshiness of the cheeks, which nearly obliterate the ridge or prominence of the nose, and also enables it to snarl, or show the teeth laterally, by the furrowing up of the sides of the lip as the baboons do. But the nose does not reach to the end of the muzzle, as in the baboons; and the nostrils are very flat and oblique. The eyebrows are very projecting, and the whole expression of the face is sinister and suspicious. This is rather increased by the tuft of long hair on the top of the head, which curves a little backwards. The hair on the body is all over of a deep black, long and shaggy, or rather woolly; but it becomes slender on the legs. The tail, like that in the Barbary ape, is a mere tubercle. The legs are rather shorter in proportion than those of the baboons, indicating that the animal is more habitually a climber.

Those that have been enumerated are the leading species of *macacos*, to which the name of baboon has, by one or other, been applied. They are not baboons, but rather monkeys, as in a proper natural arrangement, after their characters and habits come to be a little better known, they, with the other allied species which we have not mentioned, as they have never been called baboons, would make a well-marked group, requiring perhaps division into several genera. The most obvious external distinction between them and the baboons, is the termination of the nose before it reaches the point of the muzzle, and the consequent rounding of that part of the profile, and absence of the dog-headed, or *cynocephalous* expression, which not only characterises the baboons, but is made use of as one of their names.

The second, and only remaining subdivision, comprehends the Baboons, properly so called. They are further divided by Cuvier, into *Cynocephalis* (dog-heads) and *Mandrills;* and nearly a similar division is made by Brisson into *Cynocephalus* and *Papio;* but it does not appear that there are any very essential characters upon which to ground this division, almost the only one in which there is a difference being the tail, which, in the cynocephala is as long as the body, or longer; and in the mandrills very short, and projecting nearly at right angles to the spine. But that is not so great a difference even in the single organ, and that not an essential one to any of the known habits of the animals, as is found among the *macacos;* and the other characters of the baboons are certainly more uniform than those of that group.

The true baboons are all inhabitants of Africa, chiefly of the parts of it to the south and east of the Great Desert, or, if they are found in any other part of the world, it is in the south-west of Arabia, or that portion which lies most adjacent to Africa; and it is no great stretch of theory to suppose that the one (for there appears to be only one) which is found there, is a colonist, in the same manner as the magot is on the rock of Gibraltar; and that, in both cases, the animals, finding the place congenial, have remained and multiplied. It has indeed been said that some of the race have been found in India; but the evidence is not very clear or satisfactory; and, if attention is not paid to the terminal situation of the nostrils, which is wanting in all the other quadrumana of the eastern continent, there is danger of confounding the macacos, which also have the muzzle produced, with the true baboons.

Indeed, though when the animals are seen together, the characteristic distinctions between them are very apparent, yet when we come to define them in words, there is hardly one, except this of the terminal position of the nostrils, and the squareness or truncation of the end of the muzzle to which it gives rise, that can be made perfectly clear. Both groups have the produced tubercle upon the last tooth in the under-jaw, which distinguishes them, in their dentition, from all the other quadrumana of the eastern continent; and though in the full grown animals there is a difference in the facial angle—that of the baboons being about one-fourth less than the other, yet this is a character of the adult only, for in both, but especially in the baboons, the young have the muzzle less produced, and the facial angle consequently greater; so that if we were, in this instance at least, to infer the degree of what is, perhaps, not very properly called intelligence, from the size of the facial angle, we should be led to conclude that the immature animal is more intelligent than the adult, which would be contrary to the analogy of the whole animal kingdom.

Taking them altogether, the baboons have a peculiarity of structure. When they stand upon all-fours, which is their usual position on the ground (for they walk erect with more difficulty than the macacos, and seldom attempt it for more than a pace or two), they stand more in the position of common walking quadrupeds than any other of the handed animals. Their anterior and posterior extremities are nearly of the same length, so that the line of the back is about horizontal. The fore-legs stand pretty straight and firm, and though the knees in the hind legs are rather awkward, from their tendency to bend and lower the crupper, that is in part prevented by the turning out of the toes, which throws the line of bending in the knee about half way between the front and the side. This oblique position of the joint gives greater stiffness to the leg, and consequently more firm support to the body, but it produces a shambling gait, from the tendency that the hind legs have to widen at their upper part, and plait over each other at the feet; and thus the walk of the baboon is very slow, and though some of the species are large and powerful animals, it is neither graceful nor stately. Walking is not, indeed, their mode of progressive motion along the ground. They proceed at something between a trot and a gallop, and even that is not swift in proportion to the trouble which it appears to give them; the old ones, especially, soon tire, and if there is no foe in sight which they are afraid to face, they squat down upon their callosities and rest themselves.

When in the trees, where they are more at home, though they spend a considerable portion of their time upon the ground, and even find part of their food there, in the young shoots or various herbaceous plants, and probably also in some of the aboveground tubers which are not uncommon in the warmer parts of Africa, at those seasons when the surface is denuded of green vegetation by the drought. They climb and leap with great ease and agility, so as quickly to reconnoitre the whole of the largest tree ; and though they do not swing to a branch with the same graceful motion as the Oriental apes, they spring into positions in the trees where one would hardly expect to find them.

This structure would lead us naturally enough to consider what must be the nature of their haunts ; and the character of the haunt, when once known, would lead us to the structure of the animal, as the very best adapted for it. The forests over which they range are not masses of contiguous trees, extending for many miles, without breaks, and so thick of underwood as to be nearly impenetrable by the traveller. They consist, for the greater part, of single trees, or of small clumps, with intervals between, which are clothed with rich vegetation in the humid season, but parched and burnt up in the dry. The leaping or running motion is therefore, for at least half the year, better adapted to the nature of the ground than walking would be, and the strength and agility of the animals are required in their frequent ascents and descents, which are of course far more fatiguing than the labours of those apes which inhabit the close and continuous forests of the East.

It is probable, also, that the nature of their haunts, and the severity of the labours which they are called to perform in those haunts, may go far to explain, upon the principles of natural necessity or usefulness, those parts of the character of the baboons which, when the animals are in a state of confinement, appear to be merely wanton caprice and love of mischief, without the least reality, or even traceable indication of any thing that can be called resulting good, either in supplying the wants of the creature, or in any other way contributing to the preservation of its existence.

Baboons have been so universally represented as among the most, if not by far the most capricious of all the mammalia, as passing from the most playful humour to the most violent paroxysms of rage in an instant, and without any apparent cause, as being by far too inconstant for being trusted, and much too able and willing to do mischief for not being feared ; and so well are they said to sustain the same capricious and mischievous character in a state of nature, that it is reported that the wild men of the African forests, who hesitate not to give battle to the lion and the elephant, are afraid of the baboons. It is probable that there is a little exaggeration in the tale, and also some superstition in its foundation. Wild men, however rude they may be according to our standards of civilisation—however ignorant they may be of our arts—and however inferior we may reckon their weapons, always make good their title to their birthright, by subduing the most ferocious animals which are found in their countries. Nothing shows more clearly that the mythologic fables of the ancients are mere foundationless freaks of fancy, than the accounts of the subjugation of hydras and other formidable creatures, imaginary or real, by refined heroes and demi-gods. The bravest hero of modern times, armed according to the very perfection of warlike science, would not be half so much a match for the lion, as the naked African with his rude snare, his bow and his assagai. It is not, therefore, to be supposed that, without some other cause, he would be afraid of the baboon, horrible as some of the accounts of those animals appear to Europeans.

Superstition may, however, assist powerfully, for we have the evidence of mankind in all states, from the greatest rudeness to the highest degree of civilisation, to prove that superstition can not only heighten the terrors of things which are in themselves formidable or dangerous, but that it may clothe with horrors of more than earthly mould subjects which, in themselves, are perfectly innocuous. There is little doubt that the Thoth or Mercury of the ancient Egyptians, which we find so often sculptured upon their monumental remains, was the dog-headed baboon, and not the dog—that it was in fact the very same species which is still to be met with in the east of Africa and Arabia ; and if it had so much superstitious influence upon the people as to get into the mythology of Egypt, and thence into that of Greece and Rome, we can hardly suppose that it has even now lost all effect upon the minds of a people who are known still to be very superstitious, and who have probably inhabited the very same locality from ages before the civilisation of Europe to the present time. These considerations may in so far diminish the tale of the reputed horrors which the negroes have of baboons, and that, once accomplished, may lead to some diminishing of the alleged capricious ferocity of the animals, which, according to the accounts, appears to break out without any natural cause. Some have carried the matter so far as to say, that these animals will sometimes drop down and expire in fits of capricious passion. What they may do when in confinement, and subjected to the rigours of hunger and flogging, which are among the means of education exercised upon animals, it is not easy to say ; and it is known that the native male baboon, as a free tenant of the forest in the wild, will not brook restraint, but will resist it with all his might, and as sturdily and perseveringly to the death, as the best bull dog will battle to his last gasp. But if it were clearly established, that, in a state of nature, and, as one may say, enjoying exactly that which he loves to enjoy, the baboon should show either capricious cruelty or ferocity, which had no reference to his own protection or enjoyment, then there would be an anomaly—a direct contradiction—something in *nature* which was yet quite *unnatural*.

It is a law of animal nature, that no animal offers violence except in quest of its food, or in defence of its own life or that of its species ; and as we do not know all the circumstances which to animals may appear to justify hostilities, we should inform ourselves upon that subject before we venture to accuse them of *caprice*. If we, for a moment, reverse the matter, and suppose a baboon, or any other creature, to look at the apparent causes of human anger and strife, whether on the little scale between individuals, or on the great scale between nations, it is very possible that it might, in the majority of instances of both, conclude that we acted from caprice ; and yet, if the old question, " Dost thou well to be angry ?" were put to us, there is no doubt that, while the fit lasted, we would return the old answer, " Yea, I do well to be angry, even to the death," in full conviction of its truth.

Animals have not the means of communicating to us their codes "*de juri belli et pacis*," in any other way than by showing hostilities when we break the laws; and if even the capricious baboon shall bite, or the multitude of them in the trees shall pelt the stranger with sticks, or even descend and put him to death, it is the man who, in all cases, is in fault, and not the animal. The man has his reason and deliberation, and should see the result before he begins; the animal acts from present circumstances only; and when those which command or controul its action occur, act it must, ignorant and heedless of the consequences as it is of the cause.

These remarks are not to be considered as in any way a special pleading in favour of the baboons. They are ugly animals certainly, and the very ugliest of an ugly nation, both in their appearance and their habits; but it is just as absurd to impute vice, or the perversion of reason, to them, as it is to impute the exercise of reason to the better tempered and more genteel mannered apes. But the baboons have their part to perform in wild nature, are as admirably suited for the performance of it, and perform it as well, as any other race of animals. It may be that their society is not agreeable to man, as there are not very many animals of the wild forest which have that character; but animals which have this character shun man rather than seek him: they fall back when he takes possession; and when he cultivates to a high degree, they vanish. If, therefore, they ever become offensive or dangerous to man, the offence and danger are always of his own seeking.

The baboons, are, as has been said, all rather powerful animals. The average size is about that of a wolf, but some are considerably larger. Of their manners in a state of nature very little is known; and, unless in so far as difference of size gives them different degrees of strength and daring, they appear to be very much the same. There are about six species; but some of them are not very well defined.

1. The Little Baboon (*Cynocephalus babonius*) is a smaller species than any of the others, and has not the nose quite so far produced. It is found in Northern Africa, but keeps in sequestered places, and does not appear to be very numerous. The general colour of the fur of this species is described as being greenish yellow, and the face of a pale flesh colour.

2. The Guinea Baboon (*C. papio*) is found on the coasts of most parts of the country after which it is named. The probability is, that this, and it may be also some of the others have been described as different species, on account both of their size and their colour. Baboons come slowly to maturity, not attaining their full size till they are at least eight or nine years of age; and as the muzzle continues proportionally elongating all the time of their growth, while the young ones are much more nimble in their motions and gentle in their dispositions than the adults, they are readily mistaken for different species, the more so that, if captured and brought to Europe, they rarely live till any very material change takes place in them. When full grown this species attains the height of about four feet. It has the fur yellowish brown, with large flesh-coloured callosities on the hinder extremities, and the face black. The tail is about seven inches long, strong, thick, and crooked; the whole of the anterior part of the body is very strong and muscular; so that, it can take a very powerful grasp, and also strike with the hand, and cut and wound with the nails. There is but one cub at a birth, which the female nurses long and with great care, and carries very pertinaciously in her arms even when exposed to considerable danger. In addition to its vegetable food, this species is said to be very fond of eggs, and to rob the nests of the larger birds which build in trees. They are also said to invade the plantations of the people in considerable troops, and not to be very easily driven off. Some of their achievements in this way, are, however, like many other points of their history, probably a little exaggerated.

3. The Grey or Dog-faced Baboon (*C. Hymadyras*) is a much larger species, growing to the height of five feet or more; and it is said to be very fierce and mischievous. The hair of the general covering is pale ash; but it is freckled over with minute dusky specks on the individual hairs, which give the whole a dull and somewhat changing shade. The hair round the face is very long, and flows over the neck and shoulders like a mantle.

Grey Baboon.

This species is found in the east of Africa, and in the opposite part of Arabia, especially in the finely-wooded hills of Yemen, where it often does considerable damage to the coffee gardens. Wherever there are woods or otherwise pastures to suit it, it extends along the whole south of Arabia to the Persian Gulf. The full-grown males are very formidable in defence; and they are even said to be often the first to attack, though, upon the principle already alluded to, we cannot accurately know the point at which they are prompted to act upon the defensive, and therefore we may consider attack that which is really defence on their part. The nose and muzzle of this species are very much produced; the face, as well as the hands, are black. There appears to be some differences of colour, and also in the degree of production of the hair which composes the mantle at different ages, or different stages of the growth, and these have led to some confusion. The tail, too, is much longer than that of the other baboons, and more resembles the tail of a monkey. The habits of the animal, as well as the general characters, especially those of the head, are, however, strictly those of a baboon, and the manners are such as not to be easily mistaken.

4. The Pig-faced Baboon (*C. porcarius*) is an inhabitant of Southern Africa, and plentiful in some parts of the colony at the Cape. They, however,

keep chiefly to the mountainous parts, and seldom visit the plains except about the time that the crops are ripe, when they often come in troops to plunder the plantations and gardens; and they are so bold and daring on their predatory visits, that it is not easy to drive them away, except by fire arms, at the sound of which they are said to be alarmed. When assailed in their native rocks (for the summits of the rocks rather than the trees are their places of strength), they are said to have recourse to some of the means of defence which the keepers of castles, before the invention of artillery, were in the habit of using against assailants. They throw stones with their hands with very considerable aim and effect, and they also roll down much larger stones than they are able to throw. Along with a considerable share of rather lively mischief, they are said to have more fun in them than many of the other baboons, and to resemble monkeys in their disposition to play tricks. It is said that when they discover a single labourer at his meal in the fields, they steal gently behind him and snatch away part of his provisions; and that they do not make off for their fastnesses with the stolen property, but remain and tantalise the person whom they have robbed. They sit down at a little distance, and begin to eat what they have taken, with the greatest coolness imaginable, holding it up so that the party may see it. It is also said that they are the most imitative of animals; but many of the stories that are told of them must, of course, be received with considerable allowances. It is tolerably well authenticated however, that they have not the sullen disposition of many of the other baboons; that

Pig-faced Baboon.

they are much more given to tricks, and can be rendered more docile in a state of confinement, though when they have attained a considerable age, they cannot, the males especially, be tampered with with impunity. They are said to be very apt to resent injuries, even at a considerable time after these have been inflicted; and as their bite is very sharp and severe, and given without warning, they are thereby doubly dangerous. The bite of the quadrumana, even when they have the canines long, as is the case with the baboons, is not generally given with those teeth but with the incisors: it is therefore not a tearing but a cutting bite; and when they are much irritated and bite hard, they often cut off the piece which they seize as completely and with as even an action as if it were removed by a knife or any other cutting instrument.

Many anecdotes are told of the imitative propensities of the pig-headed baboon. Of these a considerable number are no doubt exaggerated, but still there must be some foundation. We shall mention one as a specimen, without either doubting or vouching for its accuracy:—a Mr. Boodle had one in a state of domestication, which he treated with considerable attention, and that the animal repaid by a close imitation of every thing imitable by him which he saw Mr. B. do. One day the apothecary sent a box of aperient pills, of which two were a dose. Mr. B. took the prescribed number in presence of the baboon, and shutting the box, deposited it on the mantel-piece of the room. The moment that he was gone, the imitative animal seized the box, and set about helping himself to a dose of the pills.

This species is sometimes called the *black baboon*, but the black upon the general covering is marked with greenish and yellowish, and the produced hair upon the sides of the face is grey; the face and hands are black.

5. The Mandrill (*C. maimon*). This is one of the species which Cuvier separates into a different genus from those already mentioned. The chief grounds of separation are, the muzzle very long, the tail very short, and the disposition more savage and ferocious than that of the others, none of which are very clear and satisfactory as generic characters. The mandrill, however, is a very singular animal both in form and in colour. The form is accurately given in the plate "Baboons." The prevailing colours of the adult male are, greyish-brown, inclining to olive on the upper part; there is a small beard of a lemon-yellow tinge on the chin; the cheeks are blue and furrowed; the nose red, brightening into scarlet at the point; some of the other naked parts are red; and the callosities on the buttocks, which are large and conspicuous, are bright violet. This mixture of bright tints, very unusual in the mammalia, give the animal the appearance of being painted for show; and, taken in combination with his grotesque figure and ferocious expression, render him the most singular looking animal in the whole class.

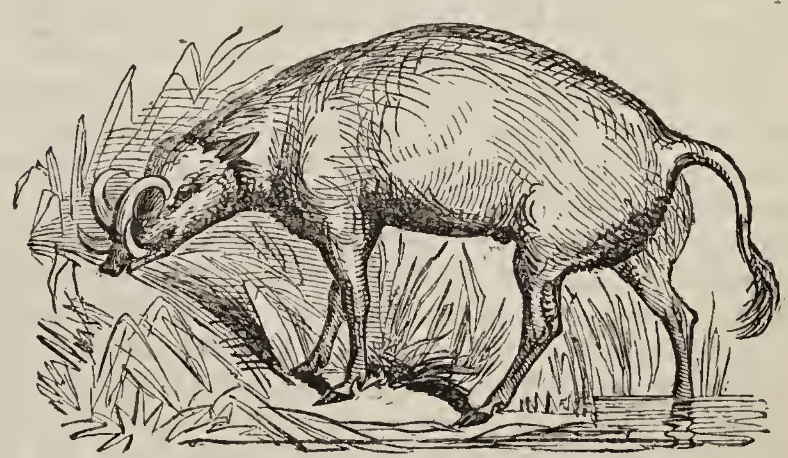
The mandrill is the largest as well as the most singular and hideous in aspect of all the baboons, and he is an animal of great size and strength, his ordinary height when full grown being about the same as that of a man; and he is very strong and muscular, especially in the head, the neck, and all the anterior parts of the body. The history of the species is very imperfect, and it is probable that it is in many particulars confounded with that of the chimpansee; the mandrill getting credit for some of the good, or at all events agreeable qualities of the chimpansee, and the chimpansee being in return saddled with some of the mandrill's disagreeable ones. The fact is not fully ascertained, but it is probable that the mandrill is proportionally as much longer in coming to maturity as he is larger in size than the common baboon of Guinea; and as the colours and the full elongation of the face appear in the mature male only, it is probable that many of the doubtful species enumerated by authors may be the young in different stages of their growth. The mandrill is more a forest animal than the common baboon; and he is not very pleasant to visit, as he is bold and fierce when attacked, and very apt to regard a visit of curiosity in the light of an invasion, and treat it accordingly.

6. The Drill (*C. leucophæa*). This species is described as being rather smaller in stature than the mandrill, and not so ferocious. Its general colour is yellowish-grey, with the face black, and the tail very short and slender. It seems to be subject to very considerable varieties of colour at different ages. In the adult male, the hair over the upper part becomes much deeper in the colour, and the chin bright red.

Head of the Drill.

Such is a list of what appears to be the principal and best authenticated species of this very singular race. The notices which we have given of them are very short and very imperfect, but it cannot be otherwise, inasmuch as no inconsiderable portion of their history rests upon no more satisfactory foundation than that of museum specimens. It would no doubt have been very easy to extend the description by the introduction of many stories of the ferocity and offensive manners of the animals, especially of the mandrill; but these stories are all probably very much exaggerated; and though they were true, the repeating of them would neither promote good taste nor useful information. The baboon has long been what is, in common speech, called "a lion," something to round a tale of the "monsters of nature," which are to be met with in the wilds of foreign parts, where the ardour of the climate may be supposed to make the earth as fertile as the imagination of the describers. But in these cases, imagination always outrages nature, and gets contrary to it, by forming its compounds out of those materials with which it is acquainted in different climates, so that they do not suit the places in which they are put. When we remember the *acephali*, the *monoculi*, and the other strange races with which the ancients peopled the unknown parts of the world, we may expect to find a little of the same attaching to all the obscure points of natural history. Good taste, and the promotion of useful knowledge, both require the repression of these matters, in order that the ground may be clear for the reception of better information, when that shall be obtained. The baboons, especially the true baboons, or the six that are last enumerated in the above list, stand in need both of more extended and accurate information, and of clearing the ground for the reception of it.

BABYROUSSA (*Sus Babyroussa*). A species of pachydermatous animal, belonging to the genus *Sus*, the pig; and sometimes, but without much propriety, called the "pig-deer," or "deer-pig;" for in the length and clean make of its limbs, and also in the covering of its body, it differs from most of the genus; and the latter difference is not confined to the mere clothing, but extends also to the skin, which is much thinner, and more membranous than that of the hog. It is an inhabitant of the Oriental, or Indian Archipelago; and the mildness of the climate there, and the regular succession of food, which an animal that feeds indiscriminately upon young shoots and leaves, fallen fruits, and roots, can procure, may readily account for the difference in covering between it and those species of the genus which inhabit where the climate is less genial, and the seasons less uniform. Its general covering is soft and woolly, more so than the second, or under covering of the common pig. Its colour is paler than that of the wild boar, but it has a trace of the same tint: it is reddish or brownish ash, while that of the other is dark blackish-brown, with a slight gloss or tint of red. It has no bristles, properly so called, but still there is an indication even of this character of the genus. Among the woolly hair, which is rather inclined to curl or mat slightly, there are other hairs, considerably larger than the rest, quite straight, and of a silky or glistening texture. No lard forms under the skin, as in the common pig, at any season, how abundantly soever the animal may be fed; and from the regular supply of food, which its native localities furnish at all seasons, the accumulation of fat would not only be useless, but it would be an incumbrance. Common pigs, though one use of their thick and peculiarly formed skin appears to be to prevent changes of temperature from affecting the consistency of the fat or lard, accumulate very little fat in tropical climates, and comparatively little in the warmer countries of Europe. All animals have a greater aptitude for accumulating fat in cold countries than in warm ones; and naturally the fat so accumulated is always, to a certain extent, a store against that season when food is scarce. The native country of the babyroussa is very near the equator; and we believe that there are few instances of equatorial animals accumulating annual fat: those that feed on vegetables rather migrate if there be seasons when food fails; and the *carnivora*, whose subsistence they form, of course migrate along with them. The genus *Sus* are not much of migrants in any country, their chief marches being from the forest to the fields, and from the fields back again to the forest; and, as already hinted, the species under consideration has little occasion to migrate.



Babyroussa.

From the above figure it will be seen that the general character of the animal is in some respects that of a pig—a handsome pig, as compared with the wild boar, or even the best-shaped varieties of the domesticated pigs, but still, to all intents and purposes, a pig. The snout is produced, cartilaginous, and flexible; and though some of the accounts say that the babyroussa does not *root* up plants after the manner of pigs, the snout is certainly one that *could* be used for that purpose—in fact, one formed expressly for it; and if it has not been observed so using it, the conclusion is, that it had no necessity for doing so. Though rooting-up is a general habit with tame pigs when they are let into pastures where there is nothing but grass, it must be considered as a dernier ressort with them when in a state of nature; for in the forest of deciduous trees, such as oak and beech, which are their favourite haunts, the cartilaginous nose is used chiefly for the purpose of pushing aside the herbage, so that they may get at the fallen acorns and mast; and while these last, they never root up grass or any other plant. When necessity compels them to have recourse to grass and other herbage, the parts which are blanched under ground suit both their taste and digestion better than those which are above the surface and green. Their teeth are not so well adapted for chewing grass as those of grazing animals; and their digestive system is much more simple: thus they require more succulent and nutritious food, and they find that in the roots of plants, especially when the vegetation of the part above ground is not very vigorous. It may be that, from the nature of its pastures, the babyroussa may not generally practise that operation; but it is evident from its structure that it could find its food in that manner if necessary.

The form of the head, the size and position of the eyes, which are small and oblique, and the shape of the ears, are all pig-like; and the thickness of the neck shows that the animal is formed for overcoming resistances by the action of the snout, without giving an impulse to the body by means of the feet. The body, though not quite so thick in proportion to its length as that of the wild boar, is still formed after the same model; and there is the same fulness of muscle on the upper parts, both of the fore and hind legs. The tail is longer than in the wild-boar, or the common hog, and it ends in a brush; but still it is a true "pig-tail"—slender, round, and, though sometimes straight, admitting of being curled. The feet also correspond, though the two middle hoofs on which the animal walks are broader, and not so sharp; and the lateral ones, which are in the rear, are not quite so much produced or pointed, as those in the wild-boar. The feet are less apt to sink in soft ground; and that, with the increased length and lightness of the legs, indicates that, in its ordinary habits, the animal travels more in quest of its food.

The most extraordinary parts of the babyroussa are its tusks. They follow the general character of the genus in sticking out of the mouth; but they are more produced, and different in form. There is an approach to the same character in the Ethiopian boar, in which all the jaw tusks, which are very formidable weapons, are curved upward, and have their points above the line of the muzzle. But the tusks in the upper jaw of the babyroussa form quite a spiral in the adult males; and though they are large and formidable, the animal cannot readily use them for the purpose of inflicting wounds. Those in the lower jaw are not nearly so much recurved; and as they are powerful, and have their points very keen, they are weapons of a very formidable description. The strength of the neck, and the action which it has when the animals "root," assist the whole genus greatly in giving those terrible wounds which they can inflict by the upward stroke; and which, if we except those given by the horn of the rhinoceros, are perhaps the most fatal inflicted by any animal. No mere bite, by the motion of the jaws alone, can make so terrible a laceration as the tusks of this genus, delivered as their stroke is, by the whole muscular action of their very powerful neck.

Still these formidable weapons, and this power of giving them effect, are defensive only on the part of the whole genus; and the same may be said of the horn of the rhinoceros. All weapons of attack which animals use when no danger is apprehended, contribute directly to the killing or capture of that upon which they feed. But the tusks of the genus *Sus* do not in any way assist them in the procuring of their food; they never use them but for the purpose of defence; and though we are apt to suppose that they make wanton and vicious attacks, we should, were we able to analyse all the cases, invariably find that apprehended danger, of some description or other, is the cause. If the defence of the animal is personal only, it seldom, if ever, shows fight, unless directly assailed; but almost all animals have, occasionally at least, other defences besides that of their own persons. The female, the young, and even the pasture, are all at times objects to be fought for; and those animals which are not carnivorous are generally more forward and more valiant in those cases than when the object is simply their own safety. The genus *Sus* probably have more powerful instruments of defence than most other vegetable feeders. Their young are numerous, and quite defenceless; and their flesh, at all ages, is, in a state of nature, sweeter, perhaps, than that of any other race of animals.

In this last respect the babyroussa is not an exception. Hence it is much hunted; and, like all hunted animals, is shy and distant. The shyness of hunted animals is rather a curious matter; and, simple as it may seem, it is one upon which mistakes are committed. The vulgar notion, both in conversation and in books, is, that the hunting is the cause of the timidity. In the case of the individual or the herd, that might have at least some appearance of truth, but it could not extend to the race; and even in the individual it is an assumption rather than a truth. The stag, which has never been hunted before, runs as readily and as fleetly as he that has been kept for the purpose, and hunted every season for years. The converse of the vulgar opinion is, indeed, much nearer the truth; and the dispositions of the animals to run, or otherwise to make their escape, seems rather to be the cause of the hunting. In most chasing animals there is what we may call a dash of cowardice—at least it is slaughter they seek, and not battle—for they all prefer catching their prey unawares, or by stealth if they can; and accordingly, those which will pursue a strong animal if it runs, will be checked, or even retire, from a much weaker one, if it stands and shows fight. Hence running, and especially running in packs or herds, is a great inducement to the animals which give chace: if overtaken, the capture will be without a battle; and the number in view render that capture more probable. There is not much truth in the common saying, that animals get shy in proportion as they are hunted by man: that cannot change the nature of the animals, though it may thin their numbers, and make them shift their localities.

The fact of the babyroussa being a hunted animal makes it less seen in proportion to its numbers; and also makes less be known of its ordinary habits. Accordingly, though it may have been known from remote antiquity, its history is still very imperfect, amounting to little more than where it is to be found, and how it endeavours to escape from its pursuers. Ælian and Pliny mention pigs with four horns, or with two horns on the forehead, and tusks like a wild boar, which comes near to the character of the babyroussa; but they *may* have meant the four-horned antelope, or the musk animal.

When alarmed, the babyroussa grunts and squeaks exactly like a pig; and though it runs more swiftly, it runs pig fashion, by leaps, throwing the whole body into the air at each bound, and *labouring* more than the proper running animals. When near water, it readily takes to that element for safety; and it swims well, so that it often voluntarily crosses rivers and estuaries of considerable breadth, and even passes from island to island when they are not far apart. As is the case with the common pig, its swimming action is the action of running or leaping, not of walking; but its blunter hoofs, and especially the greater length of its legs, prevent it from lacerating its throat with the fore-feet in swimming, as pigs are apt to do. It thus bounces away through the water with considerably more safety and speed than the common pig, though from the absence of fat it is not so buoyant. Its long nose, however, enables it to breathe easily, though it floats rather deep; and it is altogether an animal having much command of itself in the water. Its flesh is wholesome, nutritious, easily digestible, and of agreeable flavour, so that it is much sought after as an article of food.

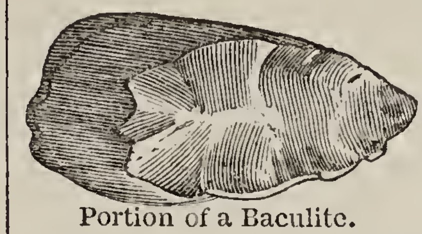
BACCHA (Fabricius). A genus of Dipterous insects, belonging to the family *Syrphidæ*, distinguished from *Syrphus* by having the abdomen very long, slender at the base, and thickened at the extremity. The face has a very slight nasal prominence, the antennæ are very short, with the third joint circular. They are found about the borders of woods, settling upon leaves, and alternately elevating and depressing the abdomen. There are six British species; the type being, *Baccha elongata*, Fabricius.

BACILLUS (Latreille). } Two genera of Orthop-
BACTERIA (Latreille). } terous insects, belonging to the family *Phasmidæ*, and destitute of wings in the perfect state; in the first the antennæ are long and setaceous, in the second they are short and subconical. The species are exotic, residing upon trees, to the twigs of which they bear so great a resemblance that they have been termed "*stick insects*."

BAETIS (Leach). A genus of insects belonging to the order *Neuroptera* and family *Ephemeridæ*, or Mayflies. Wings four, tail with two long thread-like filaments. There are nearly twenty British species, many of which have recently been described by Mr. Curtis in the "Annals of Philosophy." These insects pass the larva and pupa states in the water, from which they then emerge, and undergo a remarkable casting of the skin, after assuming the perfect form, which we shall more minutely describe under another head.

BACTRIS (Jacquin). A genus of five species of South American palms. Linnæan class and order, *Monœcia Hexandria*; natural order, *Palmæ*. Generic character: spatha double, flowers sitting. Males, calyx three-cleft; corolla three-petaled; stamens, from six to twelve. Females, calyx and corolla cylindrical; stigmas three, sitting; drupe one-seeded, three pores, but not starred; embryo within the pores horizontal. The stems of these palms are made into walking sticks.

BACULITES (Linnæus, Lamarck). A genus of shells, as yet only known in a fossil state. Its form is straight, more or less compressed, conical and much lengthened, the opposite sides smooth and depressed, sutures with lobed dentations, the septæ at irregular distances, pierced by a marginal siphon. They sometimes are found of a great size, and are abundant in all parts of Europe. De Blainville places this genus in his 1st class, *Cephalophora*; 3rd order, *Polythalamacea*, 1st family. The name appears to have been derived from baculum, a *staff*.



Portion of a Baculite.

BADGER (*meles*). A genus of plantigrade, carnivorous animals, of which the leading generic characters are: five cheek teeth in each side of the upper jaw, and six in the under; the first tooth very small, the second and third pointed, the fourth trenchant or cutting on the inner side, the fifth in the lower jaw more so, and the last in both jaws large and tuberculated in their crown. The incisive and canine teeth are like those of the generality of carnivorous animals, only the middle incisor on each side of the under jaw is inserted farther inward than the one on each side of it, though it slopes outwards so as to range in a line with the others at the crown.

The animals which the badgers most nearly resemble in the system of their teeth are the gluttons (*gulo*), but their habits are not the same. The structure of the teeth is, indeed, of that mixed kind which renders it no certain index to the food of the animal. The anterior part of the mouth, as far as the canines, is decidedly carnivorous, and could be applied with much effect in the killing of prey. It very much resembles the same portion of the system of teeth in the martens, which, in proportion to their size are among the most bold and deadly of all the carnivora; but the smallness of the teeth which immediately follow the canines, and the structure of the ones in the rear, adapt the mouth fully more for preparing vegetable substances for the stomach than animal ones; at all events, the system of cheek teeth is not adapted for bruising the flesh of large animals in the recent state. It is probable that the canine teeth of badgers, like the tusks of the genus *sus*, are weapons of defence rather than instruments of prey; and the same may, in part at least, be said of some of the other plantigrade mammalia.

The classing of plantigrade animals as carnivorous is not quite natural; and, indeed, there does not appear to be any part of the present system into which they can come with strict propriety. Eating flesh is so far from being their natural propensity, that there are few of them that will kill and eat any warm-blooded animal if they can find other food. This appears to be the case with the bears, which are considered the most fierce and sanguinary of the whole; and much more is it the case with the badgers. But the plantigrade animals are, in general, quiet and retiring, so that they are seldom seen unless when they are forced out, by natural circumstances, or by direct pursuit;

and thus their natural manners are much less known, than from the familiarity of their names and forms would be supposed. The badger, for instance, is, in some parts of Britain, not only blamed but persecuted as near to extirpation as possible, not only for being destructive to game, but for preying upon the young of the flocks. But the badger does not inhabit where game are the most plentiful, and it is seldom, if ever, found on sheep pastures. The strength, the sharp bite, and the persevering resistance of the badger, as observed by man, are all defensive qualities; and though weapons or powers which are efficient for defence, *could* be used offensively, it does not follow as a general analogy in nature that they *must be* so used. The carnivorous furnishing of the anterior part of the mouth, and the classification of the animals as carnivora, both tend to make that the general nature of their character; and thus far the imperfection of the system tends to mislead.

It is certainly desirable that the natural orders of animals should be as few as possible, because that makes the knowledge of the system more easily acquired; but they should, at least, be natural; and if the name of the order be formed upon a character, that character should unquestionably be the leading one. Carnivorous is not so as respects the badgers, or indeed the majority of the plantigrade animals of that order, as at present arranged by even the best writers on systematic natural history. In as far as analogy can hold between mammalia and birds, there is an analogy between the plantigrade animals and those birds which are usually described as *omnivorous*, —the crows, magpies, and analogous tribes; and perhaps it might not be amiss thus to distinguish these plantigrade animals, if not as an order, yet as a suborder or group. When Cuvier places them as the first tribe of the carnivora, properly so called, in his order of *Carnassiers*, one is very apt to conclude that they have the killing and flesh-eating propensities in the very highest degree, which, assuredly, is far from being the case.

The badgers have the body thick, squat, and heavy, and the legs short, but the whole very compact and strong. The head is rather slender, and the muzzle narrow; but it is not cartilaginous and moveable, so that it cannot be used in *rooting*, like the snouts of pigs. The eyes are very small, and the nictitating membrane, or third eye-lid, can cover the whole pupil; the ears are also small and rounded, and the external concha is very simple in its form. There are five toes on all the feet, having the phalanges nearly united by a membrane, and the claws on the fore-feet large and well adapted for digging. Under the tail there is a scent bag, the odour given out by which, especially when the animal is alarmed or irritated, is very rank and offensive.

Badgers, though not timid animals, but rather familiar and even playful when taken young and treated with kindness, are animals of wild nature much more than of the cultivated districts. The entrance to the burrow, which is usually placed in concealment, and so far elevated as to secure it against being flooded by water, is usually under a bush of tangled herbage and shrubs; and when this species of cover is grubbed up the badger soon disappears, being, as it should seem, deprived both of its shelter and its food.

There are only two known species of badger, the common badger (*Meles vulgaris*) and the American badger (*Meles Labradorica*).

The Common Badger is, when fully grown, about two feet and a half in length, and the tail, which is covered with long hair, is about half a foot more, the weight varies much with the individual and the season, some not being more than fifteen pounds, and others exceeding thirty. The hair with which it is covered is long, close, and fine, adhering very closely to the skin, even after that is removed from the animal and prepared by dressing. The coverings of holster pistols, the pendent pouches of those Highland regiments that wear kilts, and some other light articles for which a tough skin with fine and durable hair is preferred, are made of the skin of the badger. The hair is also employed for making a peculiar sort of painters' brushes, called 'sweetening tools,' with which those artists pass lightly over their work before it dries, for the purpose of softening and blending the tints.

Common Badger.

Upon the living animal, the skin is equally remarkable for its toughness, its flexibility, and the ease with which, from the loose nature of the cellular tissue under it, it will rise when pinched, without including any of the flesh in the fold. From these properties of the skin, as well as from the thickness and softness of the hair, and the difficulty of either cutting it or removing it from the skin, the badger is very difficult to bite, at least in such a manner as to wound or injure it. Even the skin is not easily pierced by teeth, and it is very difficult to tear, so that when dogs assail the badger, they, if they are not peculiarly trained, merely take hold of the skin and shake that, without occasioning any serious injury or even much pain, while the badger bites very sharply in return. From these circumstances, as well as from the offensive odour which the scent-bag never fails to emit when the animal is assailed, the badger is very little hunted in a state of nature. It thus dwells as much at peace with and in safety from the other animals, as it dwells quietly in itself.

It is a very quiet and inoffensive animal, more so perhaps than any other quadruped of the same size, for it hurts neither animal nor plant, at least in those species in which man takes an interest, or upon which he sets a value. Its food is understood to be fruits, roots and grass, and also insects and other small animals, though not any thing larger than a lizard or a frog. It is not capable of climbing, and thus it can injure nothing which grows or perches upon trees, bushes, or tall stems; and as it usually keeps its burrow during the day, the live part of its food must consist only of those creatures which come out to feed during the night, many of the mollusca, and other small animals which have that habit. It is thus very probable that badgers are of service as scavengers in those places which lie near their burrows, by destroying animals which, but for them would, in the natural state of those rude places, become noxious from their numbers, and destructive from their havoc upon vegetation. In some parts of the country, the badgers have been most unfairly accused of invading the mansions of the dead for the purpose of gratifying their appetite. Their facility in burrowing, and their offensive odour, may both contribute to strengthen such a prejudice on the part of the ignorant. But it is, nevertheless, totally without foundation. Badgers burrow, not for the purpose of eating, but that they may have warm and safe berths, which they render comfortable by bedding them with soft grass; and they would not eat the contents of graves, even if offered to them without any trouble on their part. The writer of this article remembers, when a boy, being present at the extirpation of a small colony of badgers which stood accused, by current report, of this species of profanation. The surface of an upland, but rather rich district, was finely diversified by swelling knolls along the north bank of a winding rivulet; and as the rivulet had, according to the custom of rivulets, "taken from the height and given to the hollow," there were steep and tangled banks at different places, open to the south-west, which was the descent side of the country; and snug and warm, and as well adapted for both birds and badgers, as thickets of fragrant broom upon sloping banks could be. The name of the badgers operated in some sort as a protection to the birds, as the boys seemed afraid to venture far into the brake in their nesting excursions, lest they should slip a leg into a badger's hole, and be drawn out *minus* a toe or even a foot. So linnets, and black-caps, and white-throats, reared their broods, and sung "round," and in high glee, protected by the mighty name of the badger.

One of these tangled banks was immediately below an ancient place of sepulture, where, previous to the Reformation, there had been a little chapel. This place was still the burial ground for the barony, and it was a place not altogether free from the suspicion of things unearthly. There was a large equisitum tufted pool, between the knoll of which the cemetery occupied the summit and the higher grounds above; and *ignes fatui* sometimes sported on its margins under the suspicious name of "elfin candles." Besides, immediately under the south-west angle of the little enclosure, there flowed a fountain of pure and sparkling water, so abundant that it would have sufficed permanently to turn a mill. This fountain abated not a jot of its quantity, and altered not a degree of its temperature, summer or winter, wet or dry; and while all around was coated with snow to the depth of two or three feet, this fountain not only remained "clear in the eye," but the stream from it flowed smoking along an open channel, which was proof alike against the powdering snow and the curdling frost. The springs of these things, fountain and all, lay deeper than the rustic philosophy, and thus, as the general custom is, they were sent to the limbo of superstition, and all whom immediately thereabout dwelt, along with them. The sod upon some graves, one summer, sunk deeper than had ever been known to proceed from the mere insatiate yawning of that "daughter of the horseleech" for the relatives of the occupant; and the suspicion of foul play—foul play to the brim of horror's deep chalice—fell upon the badgers. The "landwehr" were summoned; and they came, girt with fierceness or with fear, and armed with spades, mattocks, and pitchforks, to take by sap and mine the stronghold of the grey-pates, and let the light of heaven shine upon the den of their secret abominations. One party plied the work with mattock and spade, while another stood with their arms prepared in case the besieged should make a hostile sortie, or attempt escape; and to guard against the latter some dozen of curs had been brought as auxiliaries. At length they came to a little chamber, in which there was a small quantity of withered grass, but not a single vestige of bone or other animal remains. Again they worked away; and soon the male badger made his appearance and his escape, the opening ranks on either side greatly contributing to speed the latter, and one man declaring with "*ecce signum*" display, that the monster had "dinted a steel spade with only a passing snap." Two or three grievous whines from the curs, gave proof that the badger could "dint" something else; and soon a most triumphant flourish of yelping announced that he was fairly in the next cover and the danger over. It was now resolved to change the mode of attack, and proceed by fire and smoke. When these were continued till it was judged that all within must be either roasted or suffocated, they began to dig anew, and after passing another chamber which contained only grass as before, they came to a third containing the bodies of a suffocated female and three cubs, the latter very small in size, and two of them clinging to the teats of their mother. These bodies were not treated with that decorum which became a generous foe in the hour of victory. It was found that the excavation reached no farther than the entrance, and the three chambers, so that the badgers could have had no subterraneous communication with the graves, which rendered the sunken appearance more a matter of alarm than ever. Throughout the whole burrow there was not the smallest vestige of any animal remains; nothing but "beddings" of grass, rather more abundant in the chamber where the family was, than in any of the others. The result of the search did not, however, remove all stigma from the character of the badgers. The story is mentioned as one instance of the means by which the characters of animals come to be misrepresented. They have one or two traits of appearance or habit which do not suit the popular taste, and by means of loose analogies, often drawn from subjects of a totally different character, others are added, till the truth is completely buried under a mass of exaggeration. The cause, a very general one, though not so often mentioned as to put people on their guard against it, is this: A has several qualities in common with B, C takes up some of the qualities of B which are not common to B and A, and drops some of those that are. The series proceeds in the same way, with a marked likeness between every consecutive pair, till all the qualities of A are left out; but still, taking advantage of the whole succession, and giving the last all qualities of the first.

The common badger is pretty generally, though in no place very abundantly, distributed over all the colder parts of the temperate portion of Europe, and some of Asia. Much cold and much heat appear to be equally unsuited to its habits. The first, it seems constitutionally, but ill able to endure; the second when accompanied by severe drought, appears to be contrary to its habits; and may be so by keeping the frogs and mollusca off its pastures during the night. It does not appear to have been known to the Greek naturalists, at least it has no name in the Greek language. But the knowledge which the Greeks had of nature applied to places to the east and south of Greece rather than to the north and west; and thus their knowledge lay in the opposite direction to that in which they would have found the badger. The Romans, on the contrary, whose knowledge did extend to the west, and for some distance at least to the north, not only were acquainted with the animal, but had two names for it, *melis* and *taxus;* and sometimes the one, sometimes the other, and sometimes both of these, have been used as the name by modern systematists, since the animal was, very properly, separated from the bears, of which genus it was made a species in the system of the great Swedish naturalist.

It is probable that, in the days of the Romans, the proper locality of the badger lay in a more southern latitude than it does at present, because it is certain that the climate along the line of the Danube was then as cold, if not colder, than the southern shore of the Baltic is at present. It is doubtful, however, whether it ever extended so far to the south-east, as that the "badgers' skins" which are mentioned in the Bible as forming part of the hangings of the tabernacle prepared in the wilderness could have been the skins of the *melis* of modern times. If it had been so common in the "wilderness," (which has either undergone great physical changes, or else it must have been a very unlikely and even unnatural haunt for badgers,) it is not easy to see how an animal so common, and of which the skins appear to have been in so much request, could be unknown both to the Egyptians and the Greeks. But, at the time the standard translation of the Bible was made, natural history was in a very imperfect state; and the translators, in turning the whole book into English, were of course confined to the use of such English names, both for plants and animals, as were then known; so that, however the nervous vigour of the style then in use by the best writers (now somewhat altered and not for the better) may have been calculated to do justice to the sentiment and the sublimity of the sacred volume, there is no question that the way in which the natural history has been translated is calculated to mislead the ignorant. Therefore, a natural history of the Bible is very much wanted. But it is a work, the proper execution of which would be attended with difficulties of no common magnitude; and when we consider the brevity of human life, the large portion of it which must elapse before the preparation for such a work is begun, and the vast extent, difficulty, and even incongruity of some of the essential elements, it is a work of the appearance of which in a style worthy of the subject we may almost despair. If attempted by the unworthy, and bungled, as has been the case with many other important but difficult subjects, the evil will be made worse, the errors more difficult to be eradicated. Without such a work, the progressive natural history of the central parts of the eastern world cannot be made complete, as it wants the beginning; while the Bible, if we could rightly apply the truths which it contains, would give us facts and fix their date at a period anterior to that of any other authenticated history.

The badger is an animal of very peculiar localities certainly, but it is so fond of concealment, and comes out so much in the dark, that we can hardly describe it as being characteristic of any peculiar climate, or land, or surface, or say what stage of a country, either in its natural or its artificial changes, accords the most with the abundance of its numbers. It is not an animal of the forest, of the dry heath, of the arid waste approaching to the sandy state, or of the humid tracts which border upon inundation. There is no broad locality, no general description of surface, which we can call the badger's country, as we call the green savannah the country of the buffalo, the wild upland the country of the deer, or even the sandy plot by the seashore with its short grass and its stunted furze bushes the natural country of the wild rabbit. The best approximation which we probably can make, though it certainly is a loose and wide one, is that the badger is an inhabitant of the country in what may be called an intermediate state between the close forest and the open champaign; that it indicates that state of things in which man *should* cultivate, because his cultivation would be attended with advantage, but it is not a sign that man *does* cultivate, at least to the extreme breadth of the land. The place which the badger inhabits must be a wild spot, and though our information upon that part of the subject is imperfect, it is probable that the pasture on which the badger finds its food must also be in a great measure wild.

But though the badger does not furnish us with those means of judging from country to animal, and conversely from animal to country, so that if we have half the information either way, we can arrive at the other half by analogy, which we have in many other species, it is still a very interesting animal, and one the study of which may furnish a good deal of information. Badgers have no quarrelsome or pugnacious disposition, either against each other or against animals of any other kind. They are not strictly social, neither are they altogether solitary. Their common habit is to live in pairs, which are attached to each other, as is understood, for life. But in places which are very favourable for them, more than one pair may be found in the same small copse or brake, or even sometimes in the same burrow; though it is also said that the male and the female separate during the last stage of gestation and the early one of the suckling. It is probable, however, that this separation extends no farther than in the occupation of different rooms in the same burrow (for all the completely-formed burrows have separate rooms), and the nursery, which is understood to be more exclusively the work of the female, is more spacious than the rest, and more abundantly and completely bedded with grass. The young are produced in the warm season; and their number, which is generally from three to five, is perhaps never more than that of the teats of the mother, which is six. They arrive at maturity in two years, though they continue afterwards to increase in size; and indeed the size is liable to considerable variations, whether chiefly owing to the supply of food is not known. As the season advances they become very fat; and when the cold sets in they pass into an indolent state, dozing out the time in their burrows, till the heat of the returning season calls them again into action, which is not very energetic at any season, though it can be momentarily roused to powerful efforts.

Badgers are, indeed, very susceptible of changes of temperature, fonder of heat and more impatient of cold than almost any other animals that inhabit such cold latitudes. When in a state of confinement, in which, if taken young, they are easily domesticated, and gentle, and even playful in their manners, they are, notwithstanding the thickness and closeness of their covering, fond of basking near the fire, and often loiter so near it that they burn patches in their fur, as is the case with sickly cats, and with the dogs of temperate climates when carried to the polar regions.

And it would really seem, that, contrary to what is the case with most animals, they have the colouring of their coats so arranged as to render them susceptible to the cold rather than proof against it. Most other animals which live in wild nature in the same latitudes, have the under part of their bodies (the neck and the thorax at least, and the abdomen as far as the region of the principal stomach) white, or light-coloured, especially in the winter. But in the badger those parts are not merely darker than the upper part of the body, they are quite black, and the covering upon them is neither so thick nor so good a preservative from cold, independently of its colour. The upper part consists of two kinds of hairs, woolly ones and silky ones, which have a shining or glistening lustre. These last are, from their structure, and also from the nature of their surface, worse conductors of heat than the others, and they are wanting on the under parts where the colour is black.

It may be as well here to mention the usual distribution of the colours, though it must be borne in mind that these colours are subject to considerable variations in different individuals, from the darkest shade, which is the prevailing appearance, up to almost complete albinoism, in which the parts which are usually grey are white, or nearly so, and those which are usually black are reddish brown. Usually, the upper part is dull grey, appearing as if the animal were in part soiled, either by rolling a white body in soot, or a black one in whiting. The colour of this grey portion is made up of particoloured hairs. The woolly ones are white, with yellowish points; and the silky white have a black portion at the middle. This mixed colour becomes lighter toward the flanks, and passes into a dull reddish white on the posterior part of the abdomen. The remainder of the under part, including the greater portion of the abdomen and the legs, is very brown or black. On each side of the head there is a black streak, beginning on the lip, and proceeding across the eye to the ear, which is black, with a white border on the upper part. The remainder of the head is a dull reddish white, which is met by the black on the under part, about the middle of the lower jaw. In addition to these markings of colour, it may be mentioned, that the feet of the badger are very amply supplied with pads or tubercles, so that it can pass over hard or rough surfaces securely, and without injury. One of these is at the end of each toe; three others, arranged like a trefoil, occupy the sole of the foot, which have an additional one on the rear of the fore foot, and two on the hind. As the badger passes the inclement season in retirement and shelter, its colours do not undergo those seasonal changes which take place in animals that are exposed to the weather.

That the colours of the badger should be the reverse of those of most animals, is not a little singular. The upper part is in the most effectual manner protected from the cold. The hair is close, and the greater part of it is white. But when we come to the under side of the animal, to the portion which covers the vital parts, we find the colour black, which is the tint most susceptible to changes of temperature. Whether, when in its burrow, or when abroad in search of its food, we find the back of the badger almost as well secured against atmospheric influence or changes, as those animals which acquire winter coats; but instead of this defence being extended to the vital parts, they are exposed more so than the corresponding parts of any other wild animal of the same latitudes. The badger must, therefore, have its vital functions more under the control of the atmosphere than any other animal, at least any other of the mammalia. It must be much more affected in this manner than if the whole had been of the same dark tint, as the non-conducting covering of the upper part necessarily throws the atmospheric action upon the under, much in the same manner as if it were well clothed everywhere else and naked there. The organs of respiration, circulation, and the chief ones of digestion, are all under the dark covering, and must be all regulated by the weather, increasing in activity as that is warmer, and diminishing as it is colder. To pass along the dry earth on a hot summer's day would, therefore, throw the badger into a state of fever; and exposure to the frozen earth, and the cold air of winter, would soon reduce it below the temperature of vitality. Thus it is, from its very structure, constrained to keep its burrow in the heat of the day, and also during the night, after the temperature has sunk below a certain degree. But still, as this is the habit of the badger, and as its food is understood to vary with the seasons, to be abundant in the heat of the year, and to fail in the winter, anomalous as it may at first sight appear to be, it is as perfect an instance of adaptation as any other creature. As it is never exposed to a high temperature, and takes no exercise but what is absolutely necessary in the finding of its food, the action of its system must, at all times, be slow, and the quantity of food which it requires moderate. When temporary colds set in, its action must, from its perfect obedience to the temperature, diminish, and so must its desire for food. The badger, in its ready yielding to the weather, is therefore as comfortable, and in as good condition at all times, as those more energetic animals which are fitted for contending with the seasons—braving both the summer's heat and the winter's cold.

The retired habits of the badger cause little to be known of it in a state of nature, as it is seldom seen unless when forced to quit its stronghold. In ordinary confinement its habits are of course altered; but there is one case, reported by M. F. Cuvier, which comes so near to a state of nature, that we shall quote the substance of it:—Two young badgers, a male and a female, were taken out of the burrow of their mother, and placed in a paved yard, which was so fenced in that they could not escape, and yet allowed them considerable range. They unpaved a portion of the yard, and dug a burrow, in which they spent the day, and came out in the night only to eat the food which was placed for them. After continuing a year in the court, they were put into a small enclosure, walled round with stone, and having a mound of earth in the centre. True to their habit of digging on sloping banks where there are stones to support their entrance, they first tried the walls all round, to find a place where they could dig a habitation. They then chose an opening between two stones, which was a little elevated above the ground, and had the upper stone projecting over it. In nature, the entrance to the badger's burrow is often under a projecting stone, which partially conceals it, and protects it from the rain. They had some difficulty in reaching this place, as it required nearly the whole length of their bodies, standing on the hind feet, and the fore feet had, in consequence, little influence upon the plaster and stones. They tried a resource, however: the male lay down close by the bottom of the wall, and the female, standing on him, could reach the desired place with more effect. All would not do; so they abandoned that place, and tried the result at others, always selecting a place under a projecting stone. In these attempts, which, though they all proved unsuccessful, were carried on with great energy and perseverance, the female was the most active, selecting the places, and being the principal operator.

After many fruitless attempts, they abandoned the walls, and betook themselves to the mound of earth, the female, as in other cases, leading the way. Even here they did not at once begin to form the burrow, but ran trial lines or trenches over a considerable part of the surface, till they came to a place which suited them, and there they began their regular operations. In the first loosening of the earth they used the nose; then they dug deeper with the fore paws, flinging the earth backwards between the hind ones, and soon using these to remove it still farther to the rear. When the heap behind them accumulated, they retreated backwards upon it, and, using all the paws, gradually removed it from the hole. Sometimes one of them would lie down to rest by the side of the other at work, and remain, though half buried in the earth, and apparently giving considerable interruption to its fellow. The male was most prone to indulge in these lazy fits, while the female was by far the most industrious in the labour.

Such is probably the best account we have of the cunning operations of the badgers, though not exactly what the animals would do in a state of nature, as they were limited to two kinds of substance, the stone wall and the mound of earth. From the repeated attempts they made to burrow in the wall, at some elevation above the ground, and under stones which projected, we are led to the kind of place which they would naturally prefer. These are stony banks, where the earth is loose and easily excavated, and the water does not stagnate.

The case of the badgers above noticed is a good instance of the working of instinct as different from reason. These young animals could have had no experience in burrowing when they were first placed in the court, and they made their burrow there in the ground. But when they were placed in the enclosure, they did not act upon their experience, and again dig in the ground; they attempted to burrow in the walls. Here, therefore, we have a principle, which can have no connection with reason, choice, volition, or experience—which can in no way arise from, or be directed by, knowledge acquired or acquirable by the animal; and yet this principle leads them to act in direct opposition to their former experience; and the repeated attempts to burrow in the wall, notwithstanding the experience of failures, shows the strength of the principle. But the disposition to burrow, to find or form a subterraneous abode, which is evidently as little connected with reason or volition as the other, is a stronger principle than that which disposes them to burrow in a particular place; so it triumphs, and they burrow in the mound of earth. The greater tendency to burrow shown by the female also points out how, without plan or contrivance of any kind, all the tendencies of an animal are linked together. The male requires the burrow only as a place of shelter during the day and the winter; the female requires the additional accommodation of a nursery for her young. Therefore, she is in part influenced by her natural instinct, and works in accordance with that before she is of age to become a mother; while the male, into whose composition no such instinct enters, takes the work more easily. We can trace something analogous in the young females of many animals, and it is a curious point in the philosophy of that very interesting, but almost inexplicable subject, instinct. See INSTINCT, for some general remarks.

A distinction between "dog-badgers" and "hog-badgers" is sometimes made by the country people; but it appears to be a distinction without any difference. The dog-badger is said to prefer soils which are light and sandy; the hog-badger those which are more rich and loamy; and the latter is said to be the more clumsy animal of the two. With the exception of the *preference* (for animals have no rational or voluntary preference, though it is not easy to speak about their habits without using the term), these allegations may be true; and yet so far from there being any difference of species, or even variety, the dog-badger and hog-badger may both belong to the same litter, or the same individual may be a dog-badger one year and a hog-badger the next.

It has been mentioned how much the badger is under the controul of the atmosphere; and the state of the atmosphere is so much influenced by the character of the soil, that a dry sandy tract and a moist loamy one, which lie within a mile or two of each other, may have as much difference of temperature as if they differed a degree in latitude. Colour, size, condition, and along with that shape, may vary considerably in different countries, or in different parts of the same country; and there is not the least ground for supposing that all the badgers of the eastern continent, from the British islands to China, are of the very same species.

In no country are they found at a great height above the level of the sea, or in places which are subject to much rain or to burning drought, though from the situations in which they live, and the effect of cold upon them, the dry is more congenial to their habits than the over-moist. When in proper season, the flesh of the badger is wholesome and palatable food; as such, it is much used in China, where the animals are encouraged for the table; but, from the fœtid odour, and some other causes, it is not much used in Europe. The odour belongs to its peculiar apparatus only, and that can easily be removed without giving the least taint to the flesh of the animal. Both skin and body could thus be turned to as valuable account as those of any of the animals which are called game. The hind quarters, when properly cured, make excellent hams. In Britain, however, the badger is seldom brought into public notice except in some of those unmeaning and disgusting exhibitions to which the ignorant and the worthless give the prostituted name of "sports;" but which, to the credit of the age, are fast becoming as unfashionable as they are useless and brutalising.

The American Badger. It was long a matter of doubt among the naturalists of Europe whether the badger was to be found in America; and after the fact of its existence there was ascertained, it was by some considered either as identical with the common species, or a mere variety of it. But it is now tolerably well ascertained that the American badger is a distinct species; and indeed it is probable that none of the land mammalia of the two continents are the same species in both, how much soever they may resemble each other in many parts of their characters. The following account, from Dr. Godman's "American Natural History," is the most circumstantial which has appeared:—"Nature has destined this animal to a subterraneous and solitary mode of life, which, together with its timid disposition and nocturnal habits, throw great difficulties in our way while endeavouring to ascertain its peculiarities. It is entirely inoffensive, and apparently feeble, but, if denied the advantages of swiftness of motion or great size, it has not been left entirely destitute of the means of providing for its own safety. The long claws on its fore-feet are admirably adapted for removing the earth, and the celerity with which it can escape from danger by burrowing, is really surprising. It is altogether fruitless to attempt to secure the animal by digging after it, as its progress is too rapid, and the depth to which it descends too great. It is only by artifice that the badger can be brought from its retreat; this is effected by the aid of dogs, smoke, &c., and when driven to the last extremity, the strength of its jaws and the sharpness of its teeth, enables the animal to inflict the severest injury on its persecutors. The body of the badger is thick and heavy, and its movements on the ground slow and creeping; there is little appearance of vivacity or intelligence in its aspect, yet it does not exhibit any appearance of dullness or stupidity. It is, in fact, endowed with exactly the degree of understanding, the proper instruments for securing itself from ordinary enemies, as well as strength and courage enough to defend itself when pressed, but little sagacity is necessary to enable it to obtain the requisite food, or to continue its kind. Neither should we indulge in reflections similar to those which are found in many books of natural history, and believe that the life of this animal is gloomy and wretched. To men it may appear gloomy or dreadful to live under ground, or to steal forth under cover of the night in search of food; but this is the only mode of life the badger is susceptible of enjoying, and the only kind of action he is capable of.

"The burrows of the badger are deep and extensive, and several individuals have been found inhabiting one excavation. Within his subterraneous retreat he passes the day in sleep, and it is not until night veils all objects in shade that he comes forth to seek his subsistence. Then, fruits of different sorts, frogs, insects, and most probably any small animals to be procured, constitute his food.

"The badger has its young in summer, and generally two, three, or four at a litter, which are occasionally brought out to the mouth of the burrow to enjoy the sunshine. The young become capable of procreating when two years old, and the period of their lives is extended to ten, twelve, or fifteen years. If taken when young, the badger is easily tamed, soon becoming quite familiar and obedient.

"The American badger is a pretty little animal, and its aspect is not unlike that of some small dogs. It is found most frequently on the plains adjacent to the Missouri and its tributaries, as well as those near the Columbia river. It is not uniformly found in the open country; Lewis and Clark sometimes observed them in the woods.

American Badger.

"This animal is about two feet five inches long, including the tail, which measures three inches, and its body appears long in proportion to its thickness.

"The fore and hind legs are short, but remarkably muscular, the fore-paws are provided with the long claws peculiar to this genus, which gives them the means of burying themselves with great celerity, even in a hard soil. The neck is short, and the mouth wide; the eyes are black and small; the ears short, wide, and appearing as if a portion had been cut off. The whiskers are arranged in four points on each side of the nose and on the jaws close to the opening of the mouth. The hairs are much shorter on the sides and rump than on other parts of the body, which imparts an appearance of flatness, especially when the badger rests upon its belly. The length of the hair is upwards of three inches, especially upon the rump, whence it extends so far towards the extremity of the tail, as to conceal it entirely, and gives to the whole of the posterior parts of the body 'the appearance of a right-angled triangle, of which the tail forms an acute angle.' Intermixed with the hair we find a small quantity of coarse pale-reddish yellow fur.

"The American badger differs from the European by generally being smaller and more slenderly formed; its head is full as long, but not so pointed toward the nose; neither is the profile at all similar to the badger of Europe. In the European animal the outline drawn from the forehead to the nose is quite straight, while in the American there is a considerable depression on a line with the eyes.

"There is also a very striking difference between the markings of these animals. In the American badger there is a narrow white line running from between the eyes towards the back, the remainder of the head is brown; the under-jaw and whole of the throat are white. A semi-circular brown spot is seen between the ears and the light-coloured part of the cheeks. Above the eyes the white marking extends triangularly for a short distance, and below it runs in a line with the eyes towards the fore part of the mouth; yet the whole eye is within the dark colour of the upper part of the head, and that colour runs at the corner of the eye, with an acute angle, into the white.

"The badger of Europe has three broad white marks, one on each side and one on the top of the head, between which there are two broad black lines, including the eyes and ears; all the parts under the throat and jaw are black. The hairs on the upper part of the body and sides of the American badger are fine, long, and greyish; in the European they are darker. In our animal the legs are of a dark brown; in the European quite black.

"Notwithstanding the European badger is generally the largest, its dark coloured nails are smaller than those of the American, which are of a light horn colour. The tail of the American badger is shorter than that of the European. The American badger weighs from fourteen to eighteen pounds."

The characters given by this accurate describer of American animals, show enough of difference for the establishment of a distinct species, such as could hardly have resulted from the difference of climate. The white on the throat, and the paleness of the colour generally on the under side, would lead to the conclusion that the American species is not affected by the weather in precisely the same manner as the common. From the proportionally larger size of its claws, which almost equal those on some of the armadillos, one would conclude that the American is by much the more expert burrower of the two; and its finer, more produced, and more lightly tinted fur, obviously fit it for existing under greater variations of climate and temperature. Whether its fur undergoes any seasonal change, and what are its habits during the winter months, are not stated.

BADISTER (Clairville). A genus of Coleopterous insects, belonging to the section *Pentamera*, family *Carabidæ*, and sub-family *Harpalides*. They are of small size, but their colours are elegantly varied with red or ochre, and black or blue. They are chiefly found under stones, in moist situations. The chin (mentum) is not toothed, the mandibles obtuse, the labial palpi have the last joint oval, and the maxillary have the third joint longer than the fourth. De Jean gives only five species in his new catalogue; Stephens describes three British (*Carabus bipustulatis* of Fabricius being the type), exclusive of two others which he has described as a distinct genus, under the name of *Trimorphus*.

BÆCKIA (Linnæus). A family of ornamental greenhouse shrubs, chiefly natives of New Holland. Class and order, *Octandria Monogynia;* natural order, *Myrtaceæ*. Generic character: calyx turbinated, limb five-cleft, persisting; corolla imposed on the calyx; stamens numerous, variable (from five to fifteen), inserted in the calyx, like so many gems within the petals; filaments awl-shaped; anthers roundish, two-celled; style short; stigma capitate; capsule three-celled, many-seeded.

BAIKALITE. A mineral found near the lake Baikal in Siberia. It is sometimes considered as a variety of SAHLITE, which see.

BALÆNA and BALÆNOPTERA. Two genera, or perhaps rather, subgenera, of *Cetaceous* mammalia, inhabitants of the sea, and including all the *toothless* or *whalebone whales*. The chief external distinction is, that the *balænæ* have no dorsal fin, and the others have, on which account they are called *balænopteræ*, or "winged balænæ." Of balæna, there is one remarkable species, *B. mysticetus*, the common black or Greenland whale; of balænoptera there are several species, which will be noticed after we have made a few general remarks on the characters, habits, and haunts of these singular and highly-interesting animals. The differences between them and the toothed whales and other warm-blooded tenants of the deep, which have partly the external forms and apparently some of the habits of fishes, but which in their internal structure and all the essential parts of their economy, are yet as truly mammalia as any of that class which inhabit the land, will be pointed out in the general article on the order CETACEA.

In modern times, *Balæna mysticetus*, has been "the whale" by way of eminence, though perhaps now other species, or rather another genus, may be as much in request, and held in fully more estimation. It is not probable that this species was familiarly known to the ancients, as they were familiar only with the animals of the Mediterranean and of the shores of the Atlantic as far northward as Britain; and their whales are represented as being armed with formidable teeth, and capable of swallowing dolphins (*Coryphænæ*, not the dolphins of modern naturalists), and other large and fast swimming fishes, which the balæna neither do nor can do. It is probable, however, that in the time of the Romans, this genus may have been occasionally seen, especially in the Bay of Biscay and on the British shores, in the former of which places the modern whale-fishery is said to have begun. That the Romans were acquainted with the size of whales on the British shores, and that these were larger than those in the Mediterranean, though one of them is described by Pliny as being sufficiently formidable to engage in the port of Ostia the emperor Claudian and his army, is certain; for when Juvenal, who generally gave effect to his satires by selecting illustrations familiar to the people of Rome, ridicules the aping of the great by the small, he takes his contrast from the dolphin and the whale of the British seas.

Quanto delphinis balæna Britannica major.

The point of which was very much increased by the whale being by common repute "the devourer of dolphins."

But though the ancients thus knew the whale, it was to them little else than the monster of the deep, serving, as in the line above quoted from Juvenal, "to point a moral," or, as in the fable of Perseus and Andromeda, to "adorn a tale," it does not, in any species, appear to have been known to them as a subject of science, or as valuable in the arts of life.

Independently of its commercial value, the whale is one of the most interesting of nature's productions. The regions in which it is usually found; its vast size; its singular form; its curious habits; its combining at once the maximum of physical strength and gentleness of disposition; and a variety of other circumstances, all conspire to render the whale the wonder of the deep. And those qualities belong in a pre-eminent manner to balænæ, the apparent simplicity of whose lives, and the smallness of the individual substances on which they feed, give them an interest superior to that of the more ferocious and formidably armed species.

The common whale may be said to inhabit the whole ocean, and its size and power render it worthy of that ample field. It is not quite so discursive over the ocean, or so frequently seen in the middle latitudes, or indeed in any places where the temperature is warm, as the more voracious whales which feed upon large fishes. Those, like the predatory land animals, are furnished with powerful weapons of prehension, so that wherever the sea is inhabited they can find food, and the shark himself cannot escape their all-powerful jaws. The common whale, on the other hand, more resembles some peaceful animal which grazes the savannah, or browses the leaves of the evergreen forests; and therefore it can remain and feed for a season in peculiar localities only.

These localities may be said to be in an eminent degree the margins of the polar ice—the very extremes and confines, as it were, of the ocean. Little is known with certainty of the times or the extent of its migrations, because its march along the mighty waters is too fleet for our observation to follow. It is said that they can move as fast as a mail coach and feed while they are moving; and as, when wounded by a harpoon, they can "take out" the line so fast that, if not watered, it would speedily take fire by the friction of the roller, it is probable that they can make equal despatch on their journeys; that is, they can move twenty-five or thirty miles in the hour, the least of which would send them 600 miles a day, or from 60° north latitude to 60° south, in the short period of fourteen days.

The velocity with which they move, and the periods at which it is probable their migrations take place, may both tend to make them in a great measure unobserved. It is probable that they pass the middle latitudes in the stormy weather about the equinoxes; and thus thousands may pass without one of them being observed from a single ship. They may make their whole course too without feeding, because of the vast accumulation of fat or blubber under the skin, which analogy leads us to conclude can, like the accumulated fat of land animals be, in part at least, absorbed as nourishment when food is scarce, or the habit of the animal prevents it from feeding, At those periods too, the young of many fishes are discursive near the surface, and these may serve for food on the passage,

These whales catch their food with the plates and fringes of the *baleen*, as with a net, and the only sense that can guide them in the selection is taste, residing in the tongue; and the current of water passing over that when the motion is rapid, must be like the stream of a rivulet. It is thus probable that they have little more selection of food than what the throat can swallow. In the balæna that is very limited, the greatest extent of the gullet not being more than would admit a hen's egg. In some of the balænoptera it is considerably wider—as much as between three and four inches in diameter; and thus, though these are much smaller, they can swallow food in larger morsels. The common large whale certainly could not swallow any fish larger than the herring; and from its summer feeding in the arctic seas, the times and places where we are best acquainted with its economy, it probably feeds very little upon fish of any description.

Whales are found near the ice, or in the bays or openings among the different ice-fields, and generally in what is termed the *green water*. This green water derives its colour from the immense multitude of small animals which are dispersed through it; and these animals, many of which are almost or altogether microscopic, appear to be the ordinary and proper food of the common whales. The creatures which colour this water may appear to be but slender cheer for the largest of all animals; but their numbers are such as to make up for their small size; and the prehensile apparatus which the whale displays, is sufficient to filter a mile of the sea in a comparatively short time.

The size of the mouth of course varies with that of the body; but a gape of more than twenty feet in length and fifteen in breadth is not extravagant. The opening of the jaws may be estimated at eight or perhaps ten feet, which is about the length of the longest plates of baleen, which are situated near the middle of the length. The section of the mouth is therefore about 375 feet, and the solid contents 3000. So that making every allowance, the whale, as it feeds along the deep, commands more water than the Thames discharges; and this immense volume of water passing regularly through the mouth of one animal, at the rate of say only five or six miles an hour, enables it to collect an incredible quantity of the small matters upon which it feeds.

The form of the mouth, the way in which the plates of baleen are arranged, and the fringes with which they are furnished both on their edges and at their extremities, enables the animal to detain every small substance which the water may contain, while the whole arrangement is such that these substances are, as they accumulate, carried towards the opening of the gullet.

It may here be mentioned that the lips of the whale have a peculiar double curvature in their lateral outline. The lower one is also larger than the upper, and has a double margin, forming a groove into which the edge of the upper lip fits when the mouth is shut, and the ends of the baleen when the mouth is open. The internal palate is formed of two curved inclined planes, one on each side, and to these the thick ends of the plates of baleen are attached by a ligamentous substance. These plates are parallel to each other, and placed across the mouth. There are sometimes several hundreds of them on each side. They are thinned off toward their inner sides, and it is to these that the fringes are attached. The plates appear to have no proper motion or muscular apparatus for effecting it. When the mouth is opened they fall pendent by their own weight, so that the fringes on their lips touch the tongue, and those on their sides reach from the one plate to the other. When the animal moves forward, the plates are bent back a little at their points by the resistance of the water, and the fringes are also turned to the direction of the throat. At the anterior part they are shorter in proportion to the middle of the gape, so that they give way and admit the water more freely; but become stiffer and offer more resistance as the throat is approached. From the great length of the gape the water escapes easily in the lateral interstices between the plates, while the eatable substances which it contains are kept back by the fringes. The bending backward at the points, sends all the food downwards in the direction of the ample and fleshy tongue, which lies like a great cushion filling the under part of the mouth. It does not appear however, that the tongue acts in directing the food to the gullet, in any other way than by influencing the *set* of the current of water that way. From the smallness of the gullet the quantity of water which reaches it must be small, and as a return by the same way that it arrives would be inconvenient, it is received into cavities in the head; and, from time to time, discharged by the operation of blowing.

The feeding apparatus and the whole operation of feeding are thus, in the baleen, or whalebone whales, very peculiar, and quite different from those of any other species of animal. Feeding, in them, can be attended with no more fatigue than what results from their progressive motion through the water, and the occasional blowing of the water from the cavities in the head. There is no motion of the jaws, or of the baleen, and it does not appear that there is much of the tongue. The food receives no kind of preparation in the mouth, but goes to the gullet in precisely the same state in which it is separated from the water by the filtering action of the baleen. Though interrupted in all parts of its progress by the plates, the current of water toward the gullet may be compared to a wedge, which gets smaller as it proceeds, in consequence of the quantity which escapes laterally. Toward the top of this wedge, the food is collected, and by that it is carried onward to its destination, the small quantity of water which carries it there being disposed of in the manner above stated. If the productiveness of the water be considered as uniform, the rate at which the whale feeds will thus be proportionate to that at which it moves through the water; and rapid motion along a bare pasture will have the same effect as slow motion over a rich one. The only efficient organ of motion in whales is the tail; and therefore, strange as it sounds in words, the tail of the whale is the active instrument in the procuring of its food. Its usual mode of feeding is near the surface, so that a considerable portion of the body is above water. That portion is wholly black in colour, and not very handsome in shape; and as there is no fin on the back, and the eyes, though well formed and even expressive, are very small for the size of the animal (about equal to those of an ox,) there is nothing animated in the appearance of the floating whale when seen from a distance. It looks like a floating log, or the top of a small dark islet; and when the jets of water and steam are thrown up in the operation of blowing, it does not require much stretch of imagination to consider the islet an infant volcano.

An animal which has its feeding apparatus formed, and which must feed, in the manner that has been described, can be, as has been already hinted, an inhabitant only of peculiar parts of the sea; and, large as it is, it appears to be the only animal fitted by nature for reaping the harvest of those places. If we were to suppose the volume of the whale divided into a million of herrings, and each of these to attempt the capture of the food upon which the whale subsists, it is probable that the whole million would not, with the snap of their toothed mouths, which is an operation of some labour in addition to their progressive motion through the water, catch one-tenth or even one-hundredth part of what the whale catches by means of its baleen. Thus, when we consider the subject we find that, large as the whale is in proportion to that on which it feeds, and singular as is the structure of its feeding apparatus, it is yet a very perfect instance of adaptation, and acts a part in nature which could not be acted by a differently-formed animal.

That it is found as a surface feeder in those parts of the sea that have the very extremes of seasonal change, is in itself a proof that its food must be seasonal. But the seasonal history of the whale's food is a subject of which very little is known, and upon which it is not easy to obtain information. The seas where both whales and whales' food are found in summer, are a sealed book in the winter. They are hidden under snow and ice; and at that period of the year when the seal is set, or the mantle spread, the storms are such that we dare not stay to see what goes on. But we have proofs from all the rest of nature, both in the preparation of living creatures for the winter, and in their state while that season lasts, that the setting in of the polar winter cannot be in any way instrumental in the production of contemporary life, whatever influence the prey which it affords may have on the life of other seasons.

The question thus becomes: whence came these countless myriads of little animals, which tinge the "green water" in the arctic seas, and form the chief food of the balænæ? Are they wafted from more genial climates by the action of currents, or are they an annual or permanent production of those seas in which they are found? The former they can hardly be, for if they migrated we should have some notice of them on their march. We should find them, for instance, dyeing the current of the gulf stream on the American shores, as that is the only permanent northern current in the Atlantic; and we should also have the common whale feeding in that current, and in the places whence that current originates,—because animals of all kinds are found in those places where their food is most abundant. There are, however, no such productions in the West Indian seas, or in any other seas within or near the tropics. The water there is usually remarkable for its transparency, so that the bottom can be seen when the depth is considerable.

The action of the tropical sun upon the sea must evidently tend to a different action of life. The solar influence there, by falling more perpendicularly than in the high latitudes, must act upon the waters to a much greater depth. The heat of the sun will have more effect on the bottom of the tropical sea at the depth of forty fathoms than it will upon that of the arctic sea at the depth of twenty feet; because in the first of those localities it penetrates straight downwards; and in the second much is reflected from the surface, and the rest is turned toward the surface by the refraction, so that, beyond a comparatively small depth, there can be neither solar light nor solar heat in the sea near the poles. But the refraction, and also the continual, or more continued presence of the sun in the summer months, will cause a comparatively greater action at or near the surface of the polar sea.

The summer action of the sun upon the polar seas is, therefore, in a great measure a surface action, while that near the equator is more an action extending to a considerable depth, or to the bottom, if the depth is not great. Accordingly, we find that the bottom of the tropical seas, wherever it can be seen, is abundant in life and growth; and that many of the productions are so highly tinted with colour, that it has been described as being "as gay as a garden;" and the more gay, the more hot and barren the adjoining land. But, even in our latitude, the productions of the sea bottom have little beauty of colour; and when we reach nearer the pole they are fewer and less coloured still.

Thus it seems that, though the influence of gravitation, and some other circumstances are removed, there is a curve of solar action below the level of the sea, in the water, just as there is above in the air. On the average this curve descends to the greatest depth at the equator, and its depth becomes less and less as the poles are approached; though, like the curve of congelation in the air, it shifts northward and southward with the seasons. Whether, therefore, we regard the action of life in the atmosphere above the mean level of the sea, or the action of the water below that level, we must understand that its range in altitude diminishes as the latitude increases. Whether they come to the level at the same point, at any period of the year, it would not be easy to ascertain; but that they—that is, the upper limit of the sun's action in the air, and the lower one in the water—do approach near to each other in the high latitudes, is certain.

It must be borne in mind, too, that in proportion as the latitude increases, and the rays of the sun fall more obliquely to the mean level, proportionally more of the action of those rays must be directed to the plane of that level, by the action of both the atmosphere and the water. The oblique rays pass of course through a much greater portion of dense atmosphere than the perpendicular ones, and are in consequence refracted downwards in proportion. By falling more obliquely on the surface of the water, they are reflected upwards by that surface; and when the angle at which they fall is very small, and in high latitudes, its maximum is only twenty-three and a half degrees more than the distance of the place from the pole, they are reflected wholly into the atmosphere, and barely heat the surface, unless by a second reflection from the atmosphere. Thus it may be considered that, in the polar seas, while the sun is constantly above the horizon, the solar light and heat are continually playing between a limited portion of the mere surface of the sea, and a limited height of the atmosphere over it; and that as the pole is approached, the extent of action, downward in the sea, and upward in the air, is continually diminishing, while as it diminishes, it becomes more uniform during the whole twenty-four hours. It is not possible to speak with absolute certainty without direct experiments, and experiments which would not be easily made in such a manner as to be perfectly satisfactory; but, from what has been said, it is highly probable that the maximum of seasonal action during the polar summer, though limited both in height and depth, is much greater at the surface than the solar action at the equator. The great rapidity with which the scanty vegetation of the arctic lands performs its functions is a proof of this: one month it is a budless bush, just escaping from under the snow; next month it is in full bloom; and the third month "the cheering purple berry big with wine" is ripe and racy. The rapid production of summer insects under the influence of the unsetting sun of those distant climes, is another proof of how powerfully the continued duration of solar heat, and the action of the atmosphere and the earth or waters, concentrating the heat toward the mean surface in a manner not altogether dissimilar from the operation of a convex or burning lens, work together in giving increased energy to the powers of life during the brief period when these are in operation. Whether those insects be produced from eggs committed to the land or to the water, they must be, for great part of the winter, at a temperature as low as the freezing point of water; and the transition from that to almost continual solar action, which comes on in brief space, has upon them an effect as great, though happening in a different manner, as that which takes place in tropical climates, where the rains succeed the seasons of parching drought. But the insects, when in their winged state, require at least some height; and therefore, though they are abundant to a high latitude over the arctic lands, their numbers diminish as the upper and lower limits of solar action approach closely towards each other.

No where on the land is the mere surface action, in these high latitudes, so great as it is over the sea. The melting of the ice, which takes place to a considerable extent during the early part of every season, no doubt retards its operation; while, on the other hand, the freezing during the autumnal months retards for a little the cooling of that portion of the surface which is still unfrozen. The operation of these retarding causes must be considered as kindly to the creatures, both in coming into their summer activity, and in subsiding to their winter repose; and the effects must be equally beneficial to the migrant races, whether of the land or of the water, which periodically go to share the bounty of the polar summer, and retire to other climates during the winter.

This great increase of production must be, to preserve that balance which is every where the order of nature, accompanied by an equal increase of consumption. The number of birds which throng to those seas is incredible to those who have not witnessed it; and there is, perhaps, no part of the whole seasonal arrangements in these high latitudes more wonderful than the production of whales' food in the green water. The greenness there is not a vegetable, but an animal greenness; but still it is not a very overstrained comparison to say, that, just as it appears to demand the largest of the ruminant mammalia to crop the green vegetable life of the temperate meadows, so does it require the presence of the largest of all the mammalia to crop, and keep down to the proper measure of permanent preservation, the green animal life of the polar seas.

The analogies which we find in nature, though often curious, and to our casual or superficial view, not unfrequently inconsistent, are yet, when we come to study them with attention, all in wonderful harmony with each other; and the coincidence which we find in point of superior magnitude, especially in the animals that browse the small vegetation of the meadow, and the balæna, which cull as their food the small surface-productions of the sea, is far from the least striking. It is true that the pastures of the ox tribe are more perennial, more independent of season than those of the whales; and that the animals are less fleet in their motions. But these are circumstances which we might expect, as no land animal, without wings, could annually migrate to the extremes of latitude. And we find that taking the ox as the commencement of the race upon land, and the common whale as the commencement in the sea, we have gradations of species or genera becoming more discursive. The balænoptera stand in nearly the same relation to the balæna, as the sheep, deer, and antelopes do to the ox, they are lighter in their forms, more fleet in their motions, rather more varied in their food, and when we come to the most discursive species, they have much less proneness to accumulate fat. As we proceed in the gradation, too, we find that the fat which they do accumulate, contains proportionally more *stearine*, and less oil. Nay, if we continue the parallel a little farther, we find that the larger toothed whales have a tendency to accumulate hard fat as the camels do in their humps; and that both of these range the warmer latitudes.

These circumstances show that the land and the sea, different as they are in their characters and productions, yet form parts of the *one* system of nature, are acted upon by the same general agents, and, as we may express it, subject to the same common laws. Therefore, though the land influences the terrestrial animal and the sea the marine one, we err if we state absolutely that the one is *a production of the land*, and the other *a production of the sea*. There is enough to show that, however the sea or the land may *modify*, or, to express it more accurately, however the animal *may be modified*, so as to fit it for the one or the other, neither land nor sea could of itself produce a single animal. As little can we say that a single animal is *self-produced;* and yet as every organisation is evolved by *itself*, and *not by its parent*, —See the article Assimilation—we find that we search matter in vain for the *cause* of its production, though we readily enough find the means of its being of one form and in one place rather than another. This holds in all the kingdoms of nature, animal, vegetable and mineral; for though the productions of the last are more simple, as having none of the characteristics of life, yet when we come to what may be properly called a natural species of mineral, we can no more find the production of that in the rest of the minerals, than we can find the production of one species of animal or plant in the rest of animals or plants. Alchymists who laboured so long in attempting to obtain gold by the "transmutation" of other metals, were as much in error as those naturalists who supposed that a goose could be produced from a bernacle shell, or an eel from the hair of a horse's tail. Both the distinctions of species and the production of species, are, therefore, without any material cause which we can name or even know, they are both known to us only as continuations of that which has previously existed; and we can trace them to no other source than a Creator. The necessity of this inference meets us so constantly that we must either at once admit it, or be contented with our knowledge of nature as a mere disjointed fragment, originating we know not whence, and continued we know not how. As such it can have no moral value, and little value of any kind, to raise it above the common class of idle occupations. But when we confess our belief in the Creatorship (for whether we confess it or not, nothing but utter and brute ignorance can prevent us from having it), the moral obligation follows by necessary connexion; and, in proportion as we advance in knowledge, it is very difficult, and must require some habit or association in more than an ordinary degree pernicious, to prevent us from in the same degree increasing in the desire of doing that which is right. Plants and animals are thus our instructors in rectitude of conduct, as well as in merely speculative knowledge: and when any of them is preeminently calculated to engage our attention, as is the case with the whales, we may always be sure that the lesson which they have to impart, is fully in proportion to that enticement by which we are drawn to the contemplation of it.

We shall now, very briefly mention the species, bearing in mind that the chief distinction of an external kind is, that the balænoptera have a dorsal fin, and the balæna have none. The presence of the dorsal fin indicates that those species which have it, go deeper in the water in their ordinary habits, than those which have it not; and this is accompanied by other characters, which also indicate differences of habit. Whether these differences are generic or only specific, is a question which must be decided by the systematists. At all events, they are a well defined group, being the only animals which capture their food by means of baleen, or whalebone in the mouth.

Balæna. The general characters of the genus are: the head very large, elevated at the blowholes; the gape wide; the plates of whalebone long; and the two bones which form the under jaw curved something in the form of ribs, and sometimes improperly called by that name. In places where the whale fishery is established, these may often be seen as gate-posts. The body becomes taper and rounded toward the tail, which is the only organ of motion, and has its breadth in a horizontal direction, or the opposite of the tails of fishes. The females have two mammæ, but no nipples; and though the mammary glands are more simple in their structure than those of many land animals, the milk is as rich, and nearly if not altogether as thick as cream. There are usually reckoned four species, of which the most important are, the *common whale* and the *Iceland whale*. They inhabit nearer the poles than any other of the whales, and the common whales more so than the others; though they all meet in the same seas, and sometimes the toothed whales are found there also.

The Common Whale, black whale, or Greenland whale (*Balæna mysticetus*), being the species chiefly alluded to in the introductory part of this article, may be more briefly noticed here. Historically, it is the largest of animals; and though the reports with which we sometimes meet of whales 900 or 1000 feet in length are certainly exaggerations, it is equally certain that whales of much larger size, as well as in much more abundant numbers, were formerly found in the Greenland seas than are found there now. The slow growth of these animals, the limited portion of the sea which appears to be properly adapted for them, and the assiduity with which the whale fishery has been for a long time carried on, may, in great part, account for the diminution. Sixty feet in length and about forty in circumference now form what is considered as a full-sized whale; and one of these will, if properly cut up, furnish upwards of one hundred tons of oil. There are tolerably well authenticated accounts of individuals formerly taken, of double these dimensions, and, consequently, as the volumes of similar animals are the cubes of their lineal dimensions, of eight times the bulk and weight. The general section of the body is cylindrical, largest a little behind the swimming paws, and becoming a little smaller towards the head, the neck also marked by some furrowing in the skin. For some general remarks on the structure of the whale tribe, we must refer to the article Cetacea; but we may mention that the neck has the same number of vertebræ as the land mammalia—as the camel or giraffe, for instance, and that the articulation of the cervical vertebræ resembles that in the armadillos. That portion of the tail which may be considered as the stalk or peduncle of the lobes, is of a conical shape, the lobes are very broad, twenty feet from tip to tip in a large specimen, and furnished with muscles of great and varied power. The terminal outline of the tail is a double curve ;. the one lobe being convex and the other concave. This form no doubt assists in some of the many motions of which the tail is capable. These are of all kinds, direct flexures and oblique twists ; so that, though the one is an instrument of prehension and the other one of propulsion, the proboscis of the elephant is probably not a finer instance of muscular combination than the tail of the whale.

The whale's tail is the most powerful animal organ of which we have any knowledge ; and in the common whale it is more powerful than in any of the other species. Other than the involuntary muscles which carry on the living functions, and the local ones which move the swimming paws, the lower jaw, and the eyes, and act in the operation of blowing, the whole mass of muscle, and the whole power of the spine of the common whale, are concentrated in the tail, which may be said to be its only weapon of defence as well as its chief organ of motion. In its ordinary habits, the common whale offers no violence to any animal, not even to the small ones upon which it feeds. It does not, in any way, bite, or lacerate, or crush : the current of water simply carries the food to the throat, and it is swallowed. An animal of this habit, could not, consistently with its nature, be the aggressor ; but the whale has many enemies, of various sizes and degrees of strength, from the largest of the toothed whales to the dolphins, and some species of fish properly so called ; and as it is not the regular food of any of these, it becomes necessary that it should be able to resist their attacks. Its defence consists in the blow of the tail, which, according to the published accounts, is more powerful than that of the toothed whales of the same size. We have not, on land, any thing but miniatures of it ; because we have neither the same mass nor the same concentration of muscular action. Perhaps the nearest resemblance to it are the kicks of the kangaroo and the giraffe, the first of which, when it takes effect, is said to kill the dingo, or Australian dog, upon the spot, and the second to fracture the skull, or even to cripple the paws of the lion. The stroke of the whale's tail, which is firm and cartilaginous, can cut a stout boat in two, or dash it many fathoms under water, according to the way in which it takes effect ; and as it is probable that it cannot strike a boat with the same force as it can an animal in the water, the well-aimed blow seems enough to stun every creature which inhabits there.

The usual colour of the whale, on the upper part, is shining black ; the under part forwards, and partly the lower lip, are pure white ; and the under part toward the tail, slate or lead colour. The white colour extends as far backwards as the vital parts, and no doubt co-operates with the mass of subcuticular blubber or fat, in preserving the temperature of the animal, immersed as the lower part of it is in the cold water resulting from melted ice. The upper part is no doubt also protected by the blubber; but the black colour forms another ground of argument in favour of its migration, it being doubtful whether a naked black skin could, under any circumstances, bear an exposure for months, or even for weeks, to a temperature of the air as low as that of freezing. The places in the middle latitudes, where the common whales have been said to have been most frequently seen, are those which point at the fact of its migrations by speedy journeys over those parts of its range in latitude which supply no food, or comparatively little. They are usually the offings of large rivers, or the return eddies of large bays, both being situations where we may suppose the return water much charged with the smaller productions of life,—the estuary of the St. Lawrence, the Gulf of Guinea, the offing of the Red Sea, about Socotora, and that of the Bay of Bengal, about Ceylon.

As is very generally the case when the female has either to defend her offspring from powerful enemies, or to find food for a voracious progeny, the female whale is said to be larger than the male. She is also generally accompanied by one young one, to which she is remarkably attentive, and which she carries clasped with her swimming paw when young. Wounding the mother only increases her maternal solicitude, and the death of the young one gives rise to the deepest expressions of maternal sorrow. Indeed, all those expressions in animals, which appear to resemble most the better feelings and more tender natural sympathies of the human heart, appear to be displayed in their fullest perfection in the whales, so that those who throw away their claims of relationship upon apes and turtles, and all those land animals whereof so much has been " said or sung," had much better claim kindred with " the monster of the deep." The poetical pets are, in the plain prose of natural history, a set of " profligate rascals." The eagle is a far more orderly bird than the turtle ; and the tiger himself is a " most moral brute," as compared with the mandrill, or even the orang-utan or the chimpansee In truth, when we come to predicate either wisdom or well-doing, as qualities resulting from any *mere forms of material substance*, be that substance what it may, we have arrived at that plastic pitch of philosophy, according to which any cause may produce any effect ; and the transition from making the animal a man, to making him a god, aye, and immolating human victims on his altar, is not, in the judgment of reason, more than a single hairbreadth removed from each other. What we regard as the kindly affections of animals, are never wanting where the circumstances require their display ; but they are no more the results of *good intentions*, than the predations of wolves are the result of an organised plan for the extirpation of the whole race of sheep.

The domestic manners of whales are, however, but little known, as we have them but in snatches, and these generally from those whose avowed business it is to kill every whale they see. They are rather cumbrous museum subjects, and can be preserved only in skeleton, as their flesh, though sweet, and even wholesome, and far from unpalatable (when young), in the recent state decays sooner in the air than that of land mammalia. From the gentleness of their manners, the mild and intelligent expression of their eyes, and many other circumstances, there is reason to believe that whales would not be difficult to tame ; and it is not among the absolute physical impossibilities, that some future Neptune may yoke them to his car, and so circumnavigate the globe in five or six weeks ; but the process is not yet begun ; neither has it been "brought out" as a scheme by any one of those marvel-manufacturers who are always astonishing the ignorant, and too often cheating the simple, by projects which involve plain and palpable impossibilities.

The period of gestation in the whale is not known; and we can judge of that of suckling only from the accounts which the fishers give of the cubs. When sucking, which is understood to last for at least a year, they are very fat, often yielding fifty barrels of blubber; but the capture of them is hazardous, on account of the boldness of the mother whale; and the mother, when suckling, is not so productive of oil. In that stage of their growth they are called *short-heads*, because the jaws are but little produced, and the plates of baleen almost rudimental.

There is one circumstance here which is worth mentioning, as it shows a coincidence where we would be little apt to look for one—a coincidence between the whale and the ornithorhynchus of the streams and pools of Australia. The mammary glands in the females of both are of the same structure, and both are destitute of nipples. The mouth of the full-grown whale, with its fringes of baleen, and that of the full-grown ornithorhynchus, with its duck-like mandibles, are most ungainly instruments for sucking. The young of both are, accordingly, *short-heads* at their birth, though the one is not as many tenths of inches, perhaps, in length, as the other is feet. The *maxillæ* of both are so short, that though they do not appear capable of drawing a nipple, they contrive to squeeze the milk from pores in the areolæ of the mammary glands. When two years old, at which age they are just weaned, and being still but imperfectly able to find their food, they are very lean, and on that account disregarded by the fishers, they are called *stunts*. When they begin to get fat, and till they have attained their full size, they are called *skull-fish*.

The *whale fishery*, of which, in the north seas, whether nearer the coast of Europe or that of America, the common whale is the chief object, is an employment of no small peril as well as profit. The details of it are inconsistent with both the nature and the extent of this work; but the reader who is fond of such subjects will find ample and correct information in "Scoresby's Account of the Arctic Regions."

When it is stated that whales are discursive, and have been seen in the middle latitudes, it should perhaps be understood rather of the *balænæ* generally, than of the common whale in particular. That species certainly can move with great rapidity, even when it plunges downward in nearly a perpendicular line; and the fat with which it is loaded could be but little impediment to it in making its way through the waters. But the great thickness in proportion to the length, together with the accumulation of fat, would, according to our notions of mammalia upon land, indicate a quiescent and hybernating animal—one which dozes out the winter in a state of inaction; and we find that to be the habit of very many of the mammalia which reside in those latitudes in which the whale is found in the summer. On the other hand, those land mammalia which migrate do not accumulate so much fat, or accumulate so much in a layer immediately under the skin; and they are of more stretched and limber form than the species which remain in the same localities and hybernate. Thus far, therefore, the common whale has both the shape, and at least one of the habits, of a hybernating animal, and it wants those of a migrant one.

But the idea of a warm-blooded animal hybernating in the water is one of which we have no instance in nature, and it is one of which the possibility, upon any known principle, is not easily made out. The old popular error, of the swallow tribe leaving the air to pass the winter under water, is now of course exploded by every one having the least knowledge of natural history; and though it be true that many of the pelagic fishes, which range the surface of the wide seas at some seasons, at other seasons plunge to a depth at which the rays of the sun have but little action, and remain there in what may be called a dormant state, yet these fishes are not only breathers of water, or of the air which is mixed with water, but they are more easily killed by being removed out of the watery element than fishes which naturally dwell at greater depths; consequently they afford no analogy which can be adduced in favour of the aqueous hybernation of whales.

Also, though it is true that the mammalia which hybernate have more disposition to accumulate fat under the skin than those which migrate with the seasons, yet the fact does not hold with those classes of animals which are more generally migrant in their natures. Migrant birds, just before the time of their migration, accumulate more fat than stationary ones; and the same may be said of migrant fishes. On this point, therefore, we must not look so much to the general law of the class, as to what appears to be the general law of migration and hybernating. The migration of land mammalia is a slow and laborious process, and they must feed by the way; and if they are vegetable feeders, they must spend a considerable portion of their time in finding food. An accumulated stock of fat is therefore less necessary for them than for those species which spend the winter in a foodless region, and must supply whatever there is of waste in the foodless season. With migrant birds and migrant fishes the passage is made by long stages, in which they cannot feed; and as, with both, there are times of exertion, we may suppose that there is considerable waste of the system, which can be supplied only by absorption of the accumulated fat.

Thus, from the form or accumulation of fat in the common whale, we can draw no certain conclusion as to the manner in which it passes the winter; and there is little in direct observation to assist us in our difficulty. We know that these whales keep more upon a particular ground than the more light and lengthened species; because, when a whalebone whale happens to be cast upon any shore in the temperate climates, that whale is rarely, if ever, the common whale. But the range is obviously regulated by the food, and the more discursive species are more miscellaneous in their feeding.

In the present state of our knowledge, the migration of the common whale is the more rational hypothesis; but still it is only a hypothesis, and one of which the proofs are not easily found. Whales have not been traced upon their journey from the one pole to the other, nor have they been found in the middle latitudes, either singly or in squadrons, in such a way as that we could positively say that they were upon their march. Indeed, the fact of their being seen in the middle latitudes at all, is one which, though confidently stated, must be received with caution. There they are seen but *en passant* as matters of curiosity, and not captured or examined closely. The passing voyagers see whales; but they do not stop to ascertain whether they are common whales or not, or even whether they are whalebone whales or toothed whales; and when the fact of their being seen is mentioned as part of the story of the voyage, they are very naturally referred to the common species, which is always meant when the whale is simply mentioned by any one belonging to the north of Europe.

The Iceland Whale (*Balæna Nordcaper*) is about the same length as the common whale, or perhaps a little longer; but it is far more slender in the body, and the form and colour are different. The head is much smaller, the lower jaw broader in proportion to the upper one, the outline of the snout a little hollow, the blow-holes near to each other, the whalebone short, the swimming paws long, the back also long, the tail very much tapered, and the lobes large—larger in proportion than in the common whale. The upper part of this species is grey, or grey clouded with black; and its position in the water is much deeper than that of the common whale. It has generally only the blow-holes and a small portion of the head above the surface, which may, in part, arise from its greater specific gravity, as it has much less fat in proportion than the common whale; but it also feeds deeper, and in more southerly latitudes, and is more active and vigorous in its general motions. Hence the probability is, that its food is somewhat different from that of the common whale, consisting more of fry and the smaller fishes which are found near the surface.

The nordcaper is said to be more ferocious, or at least bold, than the common whale, as well as more active. When struck by the harpoon, it does not *run* like the other, but makes for the boat from which the harpoon proceeds; and if it came up with that, it would dash it to splinters. From this habit, and the swiftness of its motion, it cannot be safely attacked but by several boats in company, which contrive to strike it, and draw its attention by turns till it is exhausted by wounds and exertion. The inhabitants of Iceland and of the coast of Norway sometimes capture this species, but it is not sought after by the ships which resort to the North Sea whale fishery.

Balænoptera. These agree with the balænæ in being without teeth in either jaw, in having the mouth furnished with baleen, and the blow-holes double; but they differ in having a dorsal fin, in being more slender in proportion to their length, and in being discursive over a much greater extent of the ocean. They also live more upon fish; and, some of the smaller ones especially, drive about after the manner of porpoises and dolphins, and the fishes may be seen leaping out of the water in their attempts to escape from them. Lacepede divides them into two sections: those that have the skin of the throat flat or smooth, and those which have it formed into folds or wrinkles; but it does not appear that this form is accompanied by any peculiarity of character, other than that some of the plaited throated ones are, perhaps, smaller, and more discursive than the others. There are usually reckoned four species: one belonging to the first section of Lacepede, and three to the second. In an economical point of view they are of small interest or value, compared with the balænæ. But as these are the whales of description, the balænoptera are the whales of observation, being almost the only whalebone whales which, now at least, are found in the seas, or stranded on the shores, of the temperate parts of Europe.

The Finner, or Gibbar (*Balænoptera gibbar*), is distinguished by its dorsal fin, which is often the only part of it which is seen above water, and which may be mistaken for the sail of a small boat. The gibbar is now not much longer than the common whale, that is, ninety or one hundred feet; but it is thin and slender in the body.

The head is conical, and equal to about a third of the whole length. The gape extends far back, and the eyes, which are small, are placed near its termination. The plates of baleen are short, only a few inches, or not more than they are in breadth; but the fringes on them are much produced. The swimming paws are rather long, and placed a little in the rear of the gape. The dorsal fin is far backward, about four feet long in the full-grown animal, and having its apex bent to the rear. The colour of the upper part is a uniform shining brown, that of the under part pure white; and in the young the brown is paler, and has a tinge of grey.

It is not found quite so far to the north as the common whale; and when it appears in numbers, the common whale is said to shift its ground; but for what reason is not explained. It is certainly the more active animal; but it cannot bite, or otherwise offer violence, except by the stroke of the tail; and it is doubtful whether it can deliver that with the same force and effect as the common whale. The weight of the common whale is of considerable advantage to it in the use of that weapon, by affording a more steady point of rest; and the height at which it swims in the water is another advantage, as the tail moves through the air in a large portion of its sweep. Whether these are more than counteracted by the superior activity of the fin-fish is not known, and there is no instances of any hostile rencontre between the two; but the account of the one quitting when the other arrives is as has been stated.

The fin-fish is probably more numerous than the common whale; but it does not appear to be in general so social, being found dispersed over a wider extent of sea, and seldom in those bays and openings of the ice in which common whales are found in packs, though not close to each other, like a flock of sheep, yet appearing to belong to one party.

One of the largest of this species will not furnish above two tons of oil, and the capture of it is much more arduous and dangerous than that of the common whale, so that it is but little annoyed by the fishers. As soon as it finds that it is attacked or pursued, even before it is wounded, it makes a formidable resistance, throwing the water into agitation, and lashing with its tail, so that it is not easy or altogether safe for a boat to approach it so closely as to be able to strike it with the harpoon certainly and with the proper effect.

On this account its numbers have been less thinned, and its natural habits less interfered with, than those of the common whale; so that its numbers and haunts have probably not changed so much. That it is the species which the Romans describe as, in their day, being found on the British shores, there can be little doubt; but there can be as little doubt that it must have been far more plentiful in their days than it is now. For one bark that the Romans had afloat on the British seas, it is no exaggeration to say that there are now a thousand; and yet our modern navigators so rarely see a whale, that instead of describing it as a native animal, characteristic of the country, they look upon it as a very rare stranger. Specimens are, no doubt, still occasionally cast upon the shores of Britain and France; but they are so rare that the skeletons are collected for museums, or exhibited to the public as a curiosity. Of this there was a recent instance, in a large specimen, which had been cast on shore in Flanders, being brought to London, and exhibited for many months in a pavilion erected expressly for the purpose.

The great decrease which has thus unquestionably taken place in the numbers of this species within the last two thousand years, which cannot be attributed to the assiduity with which it has been sought by the fishers, and which, if we are to believe even a reasonable portion of the old accounts, show that during that period there has been a gradual change taking place in the sea. The same facts render it conclusive that the fishing (probably it would be more correct to say the hunting) has not been the sole cause, and probably not the chief cause, of the diminished numbers of the *mysticetus*. That species is more dependent upon locality, and more limited in the nature of its food; and therefore we may naturally suppose that it would be the first to yield to the change.

The sea keeps no record of those races which have become extinct, and of which it becomes the final and total sepulchre. We do, indeed, find the remains of marine animals in deposits; but we are unable to say whether these have been stranded, like the whales which are occasionally cast upon our shores, or have perished in the ordinary course of nature; and if the remains be very different from any thing that we find now existing in the sea, it becomes of course very difficult to say whether the accumulations in which they are found be marine deposits or not. In some places, as in the hill of Bolca in Italy, we find vast multitudes of what were unquestionably former tenants of the deep; but those are always found in places where there has been volcanic action: though the evidences of that action do not explain how the accumulations were formed.

We do not hear of epizooty falling upon any species of whale, and cutting them off by thousands, as it has been known to do in the case of seals; and it is very rarely that we meet with the skeletons of whales, except in alluvial deposits, which show that they are stranded specimens, and have not perished in the course of common death among these animals. That the remains of those huge animals should be so few is a curious matter, and would lead us to conclude that the bones of the giants of the ocean are entombed in its profoundest depths.

The *kreng*, or carcase, of a whale is of such specific gravity, that, after the fat or blubber, and a portion of the flesh, are removed, it sinks; and even before the commencement of the whale fishery, the petrels and other sea-birds, which are exceedingly numerous still, no doubt existed in such numbers as even to perform the operation of removing the blubber, and tearing away much of the flesh. The bones of whales are very porous; but, like the bones of land mammalia, they contain much less gelatine, and much more of the salts of lime, than the bones of fishes. They are, therefore, specifically heavier than sea-water in all their solid parts; and, after they have sunk to the depth of hundreds of fathoms, the pressure of the water will expel the oil from their pores, and send it up to the surface to form part, and it may be no small part, of the store which is always floating there, and upon which the storm-petrels, and it may be many other surface animals, in great part, subsist. What becomes of the salts of lime, whether they are changed into chlorides or sulphates, the one diffusible through the water, and entering into new combinations, and the other forming beds of gypsum or plaster stone, while the phosphoric acid rises, and contributes to the phosphorescence which is so observable in the sea, or in its inhabitants, is matter of conjecture, not of proof; but still it is matter of very rational and probable conjecture. The ocean is a laboratory on the most gigantic scale, and therefore it is quite natural that we should find its giant inhabitants connected with its most extended and powerful operations. It is worthy of bearing in mind, too, that, in the depths of those polar seas into which it is most probable that the bones of whales descend, the powers of the ocean must work nearly alone; because the rays of the sun, slantingly as they fall on the surface there, and much as they are bent upward, both by reflection and refraction, can have but little effect, either as heat or as light, in those profoundly obscure depths.

The exploring of these abodes of darkness is of course beyond the scope of human ingenuity; but yet there is food for more than the mere fancy in accompanying the remains of the whale to this their last home—a home from which nothing can fetch them back, save that action of heat which can rend the solid strata of this earth more easily than the hailstone breaks the most slender filament of gossamer.

There can be in those depths no change of day or night, or of seasons; but, if the weight of water remain on them, the same utter and unbroken darkness while the earth endures, the chains upon all action are heavy beyond what would be readily imagined. There is a pressure of, say, one thousand atmospheres, without estimating the depth at its maximum; that is, in round numbers, a pressure of about twelve tons on the square inch. We mentioned (see the article ATMOSPHERE) that the intensity of action is always in proportion to the resistance which is opposed to it; and thus the action of heat, or any thing else that could act at those vast depths, would be a thousand times more intense than at the mean surface of the sea. If, then, the action of heat, displayed as forky lightning in the thin air, can cleave rocks, and make iron run liquid like water, or burn it as a taper, what shall we think of the energy of the same agent in the depths of the ocean! This may seem a digression from the describing of a species of animal which are found at the surface of the sea; but the continual enticement which it holds out to such digressions, is one of the great beauties of natural history. They let us see what nature is capable of accomplishing; and, by direct inference, we can know how mighty must have been that Voice, which, in one moment, spake the whole into existence.

The natural decay of the whales during the period of authenticated history, involves, as an almost necessary consequence, the ultimate extinction of the race, unless some power, of which we can form no idea, shall pass over the ocean with renovation on its wings. And when we look at the land, we see proofs of similar extinctions having taken place there. Of these the more remarkable ones are in nearly the same latitudes from which the whales are now feeding. The races of land animals that have perished from these latitudes are also, in many instances, of larger dimensions than those which are left. They appear, too, to have perished in the order of their locality commencing with the *ichthiosauri* of the waters, then marsh animals, and so on for a succession of races, till we come to the elephant, the deer, and the bears of northern forests. But the details, though of the greatest interest, belong not to this place, farther than that we can see in the whales the progress of a change in the ocean similar to those of which we find demonstrative evidences on the land.

The Beaked, or Piked Whale (*Balænoptera acuto-rostrata*), is one of the smallest, but the most active of the tribe. It is not much sought after as an oil animal; but the northern people, who also eat the last-mentioned species, set a high value upon its flesh. It gets its trivial name from the form of its snout, which is very much produced and pointed, the lower jaw projecting beyond the upper. The plates of baleen are small, light-coloured, and of a triangular shape; and the long hairs which fringe them are almost white. These small plates are numerous, amounting to at least three hundred upon each side. There is more motion of the tongue than in most of the other species; and it is capable of being elevated or inflated, and also thrust forward as far as the extremity of the upper jaw. This action of the tongue probably assists in swallowing the prey, which consists chiefly of fishes, in the capture of which it is by no means inexpert.

The skin on the under jaw, the throat, and the anterior part of the body, is formed into transverse folds, which however the animal has the power of effacing, by inflating a sort of paunch. The use of that inflation is not well known, any more than that of similar inflations of various reptiles and fishes. It has sometimes been conjectured that the inflation is a means of altering the specific gravity, but that is not very probable. It may assist in swallowing, as it extends to the tongue, and indeed the paunch extends to nearly the whole space between the lower jaw-bones. The colour of the upper part is black, and that of the throat and anterior portion of the under part white, but the furrows of the folds have a reddish tinge. This species is most abundant in the north, but it occasionally ranges southwards, and individuals have been met with in the British seas, though it is not so frequently stranded on our shores as the gibbar.

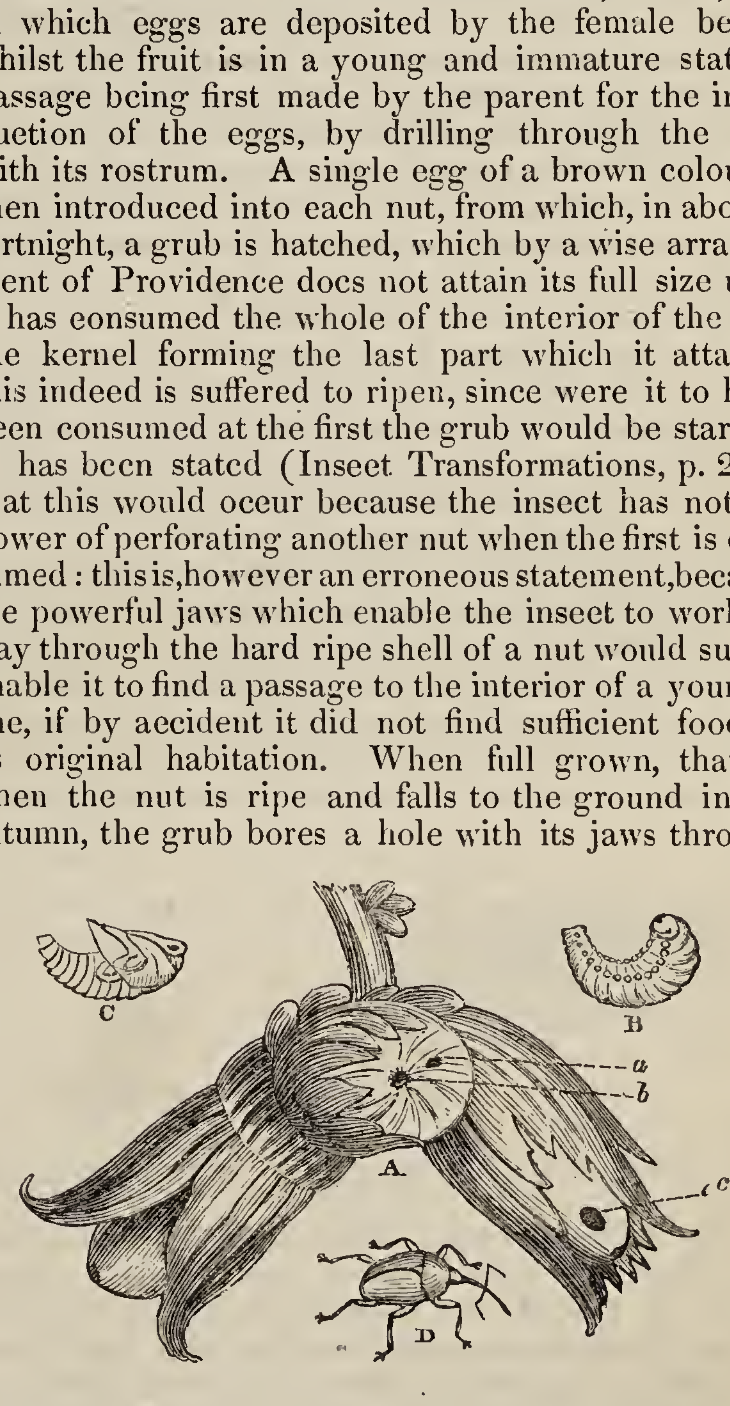
BALANETE. The name of a stone which frequently occurs in the works of Pliny and the older writers on natural history. They describe two species of it, the one yellow and the other green. It is stated to have been always found in the form of an acorn, and the probability is, that they mistook a fossil for a common mineral body. Fossils were but little known to the ancient naturalists, and when they really were found, they generally had ascribed to them some mystical or supernatural powers. The discoveries of a few distinguished men on the Continent, and in our own island, has, however, given birth to a new science and one that promises to illustrate every other part of natural history.

BALANIDÆ. The second family of the class *Nematopoda* of De Blainville's System of Malacology. The animals inhabiting and constructing these very singular mollusks have a sessile body, enclosed in their operculated shell, with numerous branchiæ in double rows, unequal, articulated, and ciliated, composed each of two cirri, supported by a peduncle and exertile; the mouth with four transverse and dentated jaws, and provided with four hairy palpi-like appendages.

All the animals of this family live constantly and immediately attached to solid submarine substances, in general at a short distance from the shore. They are found in the seas of all countries, closely placed by the side of each other in numerous groups or clusters, and in most instances so crowded that the symmetrical form of the shell is distorted by being compressed against its immediate neighbour.

The establishment of the genera, and the order in which these mollusks are now classed, is according to a consideration of the base or support of the operculum, and of the number of pieces composing the coronary part; also, the position of an internal thin separation, which doubles these shells by descending more or less towards the base; and finally, by the separation or *not* of their external surface into two triangular areas, the one concave, the other convex.

BALANINUS (Germar). The Nut Weevil. A genus of coleopterous insects, belonging to the section *Tetramera*, division *Rhyncophora*, and family *Curculionidæ*. The rostrum is very long, sometimes equalling the entire length of the body, which is of a somewhat triangular form, the thighs are thickened, and sometimes slightly toothed. In the larva state these insects reside in the interior of nuts, acorns, &c., in which eggs are deposited by the female beetle, whilst the fruit is in a young and immature state, a passage being first made by the parent for the introduction of the eggs, by drilling through the rind with its rostrum. A single egg of a brown colour is then introduced into each nut, from which, in about a fortnight, a grub is hatched, which by a wise arrangement of Providence does not attain its full size until it has consumed the whole of the interior of the nut, the kernel forming the last part which it attacks; this indeed is suffered to ripen, since were it to have been consumed at the first the grub would be starved. It has been stated (Insect Transformations, p. 242), that this would occur because the insect has not the power of perforating another nut when the first is consumed: this is, however an erroneous statement, because the powerful jaws which enable the insect to work its way through the hard ripe shell of a nut would surely enable it to find a passage to the interior of a younger one, if by accident it did not find sufficient food in its original habitation. When full grown, that is, when the nut is ripe and falls to the ground in the autumn, the grub bores a hole with its jaws through



A, a branch of the filbert tree; *a*, healed wound caused by the introduction of the egg of the nut weevil; *b*, extremity of the nut; *c*, exit hole of the grub. B, the grub of the nut-weevil. C, the pupa of the same. D, the perfect insect, *Balaninus nucum*.

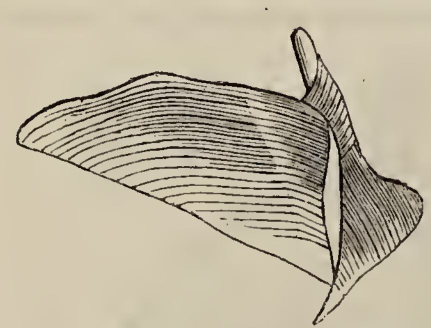
the shell and pushes itself through the aperture thus made, which, although it appears too small to have admitted of its passage, is easily effected, from the softness and contractile powers of the body, and not by the assistance of claws, as stated in the work above referred to, for the simple reason that the insect in this state is not armed with claws. The maggots then descend into the earth, where they remain all the winter, changing to pupæ, according to Rosel, in June, and appearing in the perfect state in August. There are about a dozen British species of the genus, which feed upon various vegetables: the *Curculio nucum* of Linnæus, whose proceedings are above described, being the type; it is about one-third of an inch long, and of a rich brown colour.

BALANOPHOREÆ. A natural family of monocotyledonous plants, containing only a few genera and species. By some authors the term *cynomomeæ* is applied to the order. Its essential characters are: flowers monoecious, collected in dense, roundish heads. Barren flowers, supported on stalks; calyx deeply three-parted; stamens one to three, epigynous, with the filaments and anthers united. Fertile flowers, ovary, inferior, one-celled, one-seeded, crowned by the limb of the calyx; one filiform, tapering style; stigma simple; fruit a rounded, one-celled, thick pericarp, closely united to the seed.

This is a curious order, having little affinity with any other. In some respects it resembles the arum tribe, but differs from it in possessing an inferior ovary. The plants included under the order may be said to be like the mushroom tribe in appearance. They are leafless, parasitic plants, provided with fleshy, horizontal roots, and having their stems either naked or covered with scales. They are found in warm climates, as in the West Indies, South America, and the Cape of Good Hope. Little is known in regard to their properties. The *Cynamomum coccineum*, a plant found in Malta, was formerly much used in medicine under the name of *Fungus melitensis*. It acts as an astringent, and was employed successfully in dysentery and hæmorrhage.

BALANUS (Lamarck). *Lepas tintinnabulum* (Linnæus). The arrangement of these mollusks will be seen under the article BALANIDEA, in which the general characteristics of the animal are also given.

Lamarck, and modern naturalists, have only classed in this genus such shells as appeared univalve by the connection of their valves in a peculiar manner,



One of the valves of the B. gigas.

Valve of the Acasta.

their lower part closed with testaceous matter, and the operculum consisting of four pieces. These shells are usually of a conical form, more or less elevated, sometimes narrower at the base, in the form of a tulip, irregularly shaped, from the circumstance of their being crowded together, in large clusters, on the substances to which they are affixed. Their aperture is subtriangular or elliptical; the base closed by a solid testaceous termination, firmly fixed to various bodies, the four pieces forming the operculum inserted internally near the base, forming a kind of pyramid at the upper opening of the tube.

B. Gigas.

B. spinosus.

B. spongites.

Three species now form this genus; the first is that in which there is no support, or merely a membranous one, as in the *Balanus spinosus;* the second includes those whose support is rather irregular, but usually very considerable, as in the *B. gigas;* and the third is that whose base or support is conical, hollow, nearly regular, patelliform, and found inclosed in sponges. From the form of this species, and their not being able to stand upon their own basis when detached from the substance inclosing them, Dr. Leach separated them from the genus *Balanus*, and constituted his genus *Acasta* of them. De Blainville, however, does not admit of a sufficient reason for separating them, in which opinion many modern naturalists concur.

These singular shells give rise to much interesting speculation as to the mode of their structure, which differs from all other shells; their increased growth in height and circumference is easily perceived in each of its stages, the one on the conical part, and the flake, or testaceous separation at the bottom, exhibiting the other; it may therefore be conjectured that the animal, when necessity obliges it to increase the size of its habitation, possesses the faculty of detaching the parts forming its exterior, and, after having added a given uniform portion to each, of fastening or soldering them together again, like the sutures of the human and other skulls.

Balani are named as one of the dishes at the famous gastronomic feast given by Lentulus, on the occasion of his being named "Flamen Martialis," a priest of Mars; and some species are now eaten by the northern nations. Their flavour nearly resembles that of the common mussel, but the substance is more stringy or tough. The name of this genus is derived from an acorn, *balanus*, which many species closely resemble in form.

As this genus is now circumscribed, it still includes a considerable number inhabiting all seas. Lamarck characterises twenty-nine of the two first sections, of which three or four are fossil species, and four of the second. De France enumerates sixteen fossil species, some of which are found in this country; they are, however, by no means common.

A further arrangement of this genus might be made with propriety by separating the species having six valves in the operculum, and a due consideration of the internal portion which some of the species possess double.

BALISTES (File Fish). A genus of fishes belonging to Cuvier's order, *Plectognathes* (soldered or united jaws), and to the second family of that order, *Sclerodermis* (hard skin). The name *balistes* has been given in consequence of the length of the dorsal spine, by which the fish appear to move like the arm of a cross-bow. The characters of the order will be explained under PLECTOGNATHES, and that of the family under SCLERODERMES. But it may not be improper to mention here that all the order are intermediate in their general characters between the bony and the cartilaginous fishes, their skeletons being formed of matter which is partially flexible, and the different portions partially soldered together. This is not so much the case as in the cartilaginous fishes; and it is more conspicuous in the bones of the head, more especially those connected with the upper jaw, than in any other part of the body.

It is a general law that those fishes which have a deficiency of bony matter in the skeleton have it precipitated, or accumulated, in some form on the surface of their bodies, as in the thorns on skates, the tubercles on sharks, or the plates upon sturgeons.

They are thus as it were intermediate between vertebrated and invertebrated animals, having the skeleton of the former, and partially also the shell, crust, or other form of covering, of the latter; and the condition of these two parts appears to be pretty constant as a whole, but to fluctuate in the two, sometimes going more to the one, sometimes more to the other.

In the two families of *Plectognathi*, the disposition of the osseous matter, though it is to the surface in both, is very distinct in each, so as to form a leading character. In the one division it goes to the jaws, and covers them with plates of ivory, which may be considered as continuous teeth, or teeth soldered by nature into one piece, though they have been styled *gymnodontes* or "naked teeth." In the division which includes the genus *balistes*, it goes to the external covering of the body, in osseous granulation over the skin, in strong spines to the fins, or in both. The latter is the case with *balistes*, which gets their common English name of "file fish," from the skin being granulated like a file, and the name *balistes* from the dorsal spines, or long rays in their first dorsal fins, which are not only much produced, but articulated to a peculiar bone, which enables them to perform much more motion than the dorsal appendages of many other fishes; but what function that motion performs in their economy is not known.

The general characters of the genus are, the muzzle long and conical and the mouth small (though these are rather characters of the order), the body compressed; each jaw furnished with eight teeth in a single row, the points of which are often trenchant, or partially chisel-shaped, and thus fitted for biting sea weed. Their skin is scaly or granulated, and the scales are of more consistent matter than those of the bony fishes, but they cannot be considered as absolutely bony, like the tubercles and plates on the cartilaginous fishes. The first dorsal fin is composed of one or more spines, articulated to a peculiar bone, and that bone is connected with the bones of the cranium.

The first dorsal fin is more or less moveable in the direction of the mesial plane of the body. The second dorsal fin is soft and generally large; but it varies in the different species: it is, however, in general, placed immediately above the anal fin, and the two very often resemble each other. The caudal fin varies very much in its form, being in some crescent-shaped, with long projecting points at the terminations; in others it is nearly square; in others again it is rounded, and on some it is nearly lance shaped. Many of the species are without ventral fins; but all have bones in the sides of the cavity of the body, which are articulated to the shoulder-bones. These bones are, in some of the species, capable of a very considerable degree of motion; and sometimes they are armed with spines at their extremities, and may perhaps be considered as the rudiments of ventral fins, and be in some way auxiliary in the process of swimming.

The gill-opening of these fishes is a mere slit, without gill-lid, or gill-flap; so that in this respect, as well as in some others, they approach the character of the cartilaginous fishes.

The species are very numerous, and generally inhabitants of the torrid zone, and invariably of the warmer parts of the ocean, none of them being found near the poles, or in very high latitudes; but there is at least one species in the Mediterranean, the one from which the genus was at first named by Artedi. They are usually found in the shallow water near the rocks, where their colours, which in many of the species are bright and finely contrasted with each other, have a very brilliant effect. They are said to feed upon sea-weed, and also upon the polypi by which the coral rocks of different sorts are formed; and when they feed upon the latter, their flesh is said to be poisonous, or at any rate unwholesome. It is probable, however, that their principal food is sea-weed, at least in those which have trenchant teeth; and Cuvier mentions that as being the substance he found in the stomachs of those which he dissected. The flesh of none of the species is valuable as an article of food. It is dry and tasteless, and in many of the species it is to be suspected, if not actually unwholesome.

The sizes, shapes, colours, and other external characters, which, from the very imperfect knowledge we have of their habits, are almost the only ones of fishes, vary so much that they have been divided into four subgenera,—*balistes*, properly so called, *monacanthus*, *aluteres*, and *triacanthus*; but, so far as is known, their habits all resemble each other.

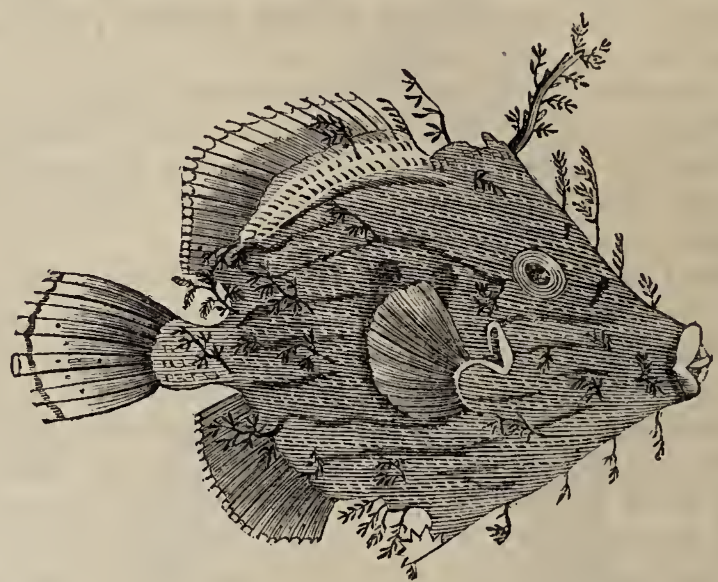
The *balistes*, properly so called, are those which, from the texture of their skins, more immediately merit the name of "file fish." They are covered with moderately large tubercular scales of a rhomboidal form and very hard texture, which are not imbricated or overlapping each other, like the scales of ordinary fishes, nor are they, as is generally the case with these, free at their posterior edges; but adhere closely to separate portions of the skin, with channels between.

There is here one point worthy of remark: the more that the scaly appendages to the skins of fish resemble bone, they are the more persistent; and when they attain the bony character it is doubtful whether they are ever shed; whereas, the imbricated scales, which have great part of their posterior edges free, often adhere so slightly that they can be rubbed off by a mere touch, and are probably shed every season, like the hair in most of the mammalia, and the feathers in most of the birds. In those species which have the scales deciduous, the colour is principally or wholly in the scales, and is subject to a change of bloom or lustre, being most bright in the breeding season. When the scales are osseous, again, the colour, in part at least, is in the skin, and the scales have not so much bloom in the breeding season. Scales of this structure and arrangement cannot be so efficient in the act of swimming as free scales; and hence the fishes which have them are either supplied with an extraordinary development of the fins, a peculiar form of body which facilitates their motion, or they are local and do not range far. Length, strength, and power of motion in the rays, are the general attributes of these fins. The body is either elongated or it is compressed laterally, the last of which is the case with the balistes. The bones of the ribs may also be considered as in some way contributing to the act of swimming; and, besides their motion, they are often accompanied by a power of extending the cavity of the body to a great extent by distension. But the balistes generally have not that power to such an extent as some of the analogous genera. In almost all cases, however, in which a fish has the power of inflating the cavity of its body, the part which it inflates is in some way armed with projecting members; and therefore one may conclude that it assists in some way or other in their motion through the water.

The first dorsal fin of the true balistes consists of three spines, of which the first is by much the longest; the last very small, and directed to the rear. The extremity of the cavity of the body is projecting and rough; and there are at the hinder part of it produced spines, which may be considered as the rudiments of ventral fins,—at least there is little doubt, that, aided by the action of the bones and the general roughness, they in so far answer the same purpose. Some of this subdivision have spines on the sides of the tail, and others have large scales or plates behind the gill-openings; but, in general, those which have the one of these characters are without the other.

Monocanthus have, as the name imports, only one conspicuous spine in the first dorsal; but they have one, or indeed two, rudimental ones, the last of which is hardly visible above the skin. The single spine is toothed on its posterior edge, the teeth being recurved like barbs; and the spine itself is much longer in proportion than in the first subdivision, having more the appearance of a barbed horn than of part of a fin.

Some of the species of this subdivision have the bones in the sides of the cavity susceptible of much motion, and the extremity of the abdomen provided with a rayed apparatus, capable of being folded and unfolded like a fan; nor is there any doubt that this apparatus aids them powerfully in their swimming. These have also spines on the sides of the base of the tail. Other species have the sides of the tail furnished with rough bristly appendages. Indeed, it is not possible generally to describe the appendages which the species in this subdivision have to the covering of their bodies. Some have their bodies beset with tubercles or little peduncles or stalks, and others have them branched, as if they were small sprigs of some kind of aquatic plant. One of the species, *pencilligerus*, of which the following is a figure, will illustrate that character.



Balistes pencilligerus.

Of *Aluteres*, which has also only one dorsal fin, the species are not so numerous, or, at all events, so well defined. See ALUTERES.

Triacanthus differs from all the other subdivisions, in having ventral fins, and the termination of the cavity of the body not prominent or bristly. These ventral fins are supported each by a large spine, which, however, does not stand out, but is united to the abdomen. Indeed, the fan-like apparatus in which the abdomen of some of these fish terminate, may be considered as two ventral fins joined together. The name of this subdivision would imply that the first dorsal fin has three spines; but it often has more (and there is but one known species) though the first spine is much larger than any of the others.

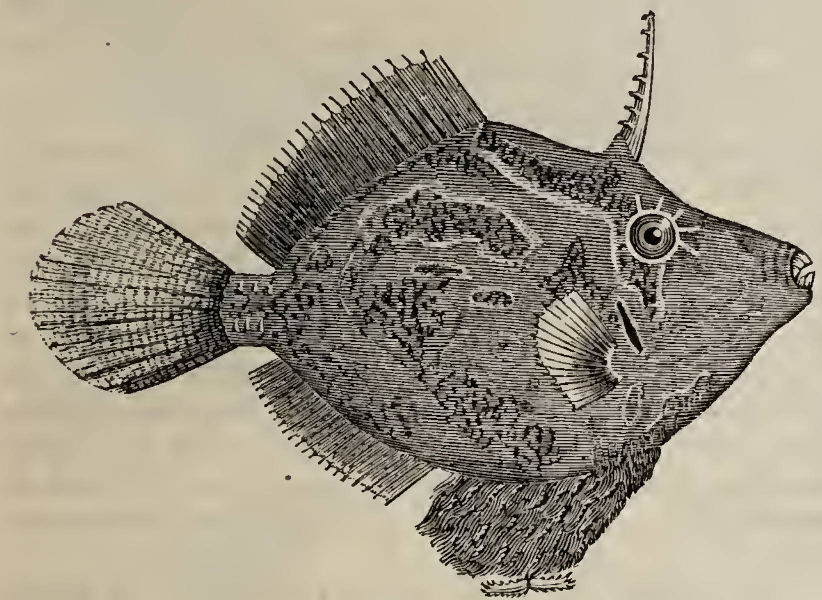
Though, as has been said, of little or no use as food, fishes of this genus attract attention by their singular shapes, and also by their bright colours; and they are known to British sailors frequenting the seas which they inhabit by the general name of "Old Wife."

An enumeration of all the species would be a long list, and it would be far from a popular one, as many of them are but little known. We shall therefore notice only a few of the more interesting—that is, of those that have been observed with most attention. We shall notice them all under the generic name balistes; and add the names of Cuvier's subgenera in parentheses where necessary.

Balistes capriscus (*balistes, C.*) is the one which has been longest known. It is the only one which inhabits the European seas, being found in the Mediterranean. The general colour of this species is brownish-grey, with blue or green stripes or spots. It is found in the Mediterranean, and also in many parts of the tropical seas. It appears to vary considerably both in colour and in size, and hence different authors have described it under different names,—which has indeed been the case with several others of the genus. The skin is smoother, and the depth of the body less than in some of the other species.

Balistes niger (*balistes, C.*) is altogether black, excepting a portion round each eye, and a bar on the basal part of the second dorsal, the anal and caudal fins, the last of which has the exterior rays produced forming two points. It has also some of the lateral teeth in the upper jaw produced, and in part resembling the canine teeth of mammalia. The dorsal fin consists of two rays, or spines, quite detached from each other; the first large, the second very small. The head is also much shorter, and the gape of the mouth much wider than in most of the other species. Instead of ventral fins, it has one large ray at the caudal extremity of the abdomen, covered for the greater part by the skin, or at all events united to it. The skin is very rough, in lozenge-shaped tubercles; most of the rays of the fins are branched at their terminations; and there are, on each side of the base of the tail, seven rows of spines curved forwards, which lacerate the fingers, if the hand be drawn from the head to the tail.

Balistes geographicus (*monacanthus, C.*) is one of the most remarkable species. Some notion of its form may be obtained from the following figure.



Balistes geographicus.

The name *geographicus* is given from the markings, which bear some resemblance to a map, the lighter part the sea, and the darker the land, with its mountains. The body is dark but compressed, the muzzle produced, the mouth rather small, the eyes large; the spine of the first dorsal prominent; and, in short, it has all the characters which have been enumerated in the short paragraph on *monoceros.* It is found both in the Atlantic and the Pacific, but only in the warmer parts.

Of *Balistes pencilligerus* (*monoceros, C.*) the figure has been already given. It is still deeper in proportion to its length, and more compressed than *geographicus.* The rays of the second dorsal, the caudal, and the anal fins, are, as in that species, bare or free from the connecting membrane for some distance at their points; and they are also more conspicuous by being farther apart from each other. The appendage at the hinder part of the abdomen is not so decidedly a ventral fin, though there is no doubt that it acts as such when the fish swims. The most singular part of its appearance, however, is the branched appendages, which are not only attached to the fins but scattered over the body and head. The first, or large dorsal spine, is very much branched, and so is the second one, which is much smaller and placed considerably to the rear of the first. The produced termination of the cavity is fringed with these appendages, and there are some of them on the forehead and cheeks. How they may act in the water is not very well known, nor is it easy to be imagined, as they appear to be singular appendages to swim with. One would imagine that, like barnacles on a ship's bottom, they would impede its progress through the water; and there is no doubt that such would be the case if the body of the fish had no flexibility, and if, like a ship, it were impelled by a force acting not in the water. But in the case of a fish, where both the moving power and the fulcrum from which that power gets the resistance to enable it to act, are in the water, the difference must be very material, so much so, indeed, that we can hardly institute any comparison, as we are not acquainted with any one mechanical contrivance which, acting wholly in the water, and equally both ways, as the fin of a fish does, which can impel itself forward. The three efficient fins of this species, the second dorsal, the anal, and the caudal, are all near each other, and they are also powerful for the size of the fish. It seems therefore that in order that a portion of their action may not be lost by throwing the head of the fish into alternate vibrations, a greater power of "holding on" is necessary; and thus these branched appendages may produce that steadiness of the body which is essential to the proper action of the fins. When we examine the lateral appearance, we find that the second dorsal and the anal extend forward nearly to the centre of gravity, and that the long spine answering to the first dorsal, and the projecting and fringed part of the abdomen, are nearly on the same line. The dorsal spine is connected with the bones of the head, and the fringe at the end of the abdomen is connected with the lateral bones of the cavity of the body, which are connected with the scapular bones.

It will readily be seen that, while the spine and the fringes prevent lateral motion at the line of which they form the terminations, the stiffness produced by the connections of bones must assist in keeping the anterior part of the fish in the line of its career steadily, while the lateral motions of the tail impel it forwards. Thus, by a careful examination of the parts, and a due consideration of the way in which, according to the known doctrines of motion, the one can react while the other acts, we may arrive at some understanding of the use even of those parts which at first sight appear to be redundant and even absurd.

The whole of this genus, and indeed, generally speaking, the whole of the order to which it belongs, are inhabitants only of the warmer seas; few or none of them are, from the form of the mouth, fitted for existing upon other fishes; and their structure is, in general, not such as that they can find their food in substances floating on the surface. It does not appear that the present genus has much of a pelagic habit; they do not range the depths of the ocean, but are found near the rocks, especially the coral reefs, which, even after the little creatures which formed them are gone, appear to abound more in living productions, both vegetable and animal, than most other rocks. Some of the fishes of this order (which appear to be among the grand destroyers of the surplus of small life on these reefs), are fitted for cutting off, with their trenchant teeth, the fronds of the fuci, while others appear to be more fitted for breaking the crusts and shells of the smaller crustacea, the young of which in particular are found in myriads among the seaweed on these reefs. Their economy in the general system of nature will, however, come better under the article on PLECTOGNATHES.

BALM. A well-known medicinal herb, the *Melissa officinalis* of botanists. Linnæan class and order, *Didynamia gymnospermia;* natural order, *Labiatæ.* Generic character: calyx upper lip flat, a little reflexed, three-toothed, the lower lip two-parted;

corolla upper lip vaulted, margined, and two-cleft, lower lip three-lobed, middle lobe largest, margined, and inversely heart-shaped; stamens, anthers kidney shaped, two-celled; style divided at top.

This plant is in every garden; a decoction of the leaves is recommended in cases of severe colds, &c.

BALM OF GILEAD. An under shrub of highly aromatic scent and qualities; the *Dracocephalum canariense* of botanists. This plant is in every green-house; and with little protection bears the severity of our winters.

BALSAM. One of our favourite green-house annuals. The beauty and variety of its flowers are very attractive; and though scentless, a specific mode of culture has been laid down for bringing them to perfection. The seed is sown, and the young plants are reared in hot-beds during the spring months, viz. in March, April, and May. About the middle of the last-named month, they should be, by frequent shiftings from small to larger pots, and from one hot-bed to another, advanced to the height of eighteen inches or more; and then are fit to replenish the green-house stage now empty; or for the decoration of halls of mansions, and the plots in flower-gardens. The balsam is one of those plants which by nature is destined to exist only one summer; but by art may be perpetuated from year to year, by the expedient of raising new plants by cuttings of the old. This, however, though practicable, is seldom practised; as they can be much more conveniently raised from seed. The seed-vessels of this genus have a remarkable property, they burst instantaneously on being touched when mature, scattering the seeds to a considerable distance: botanical name, *Balsamina hortensis.*

BALSAM APPLE. A climbing annual, native of India; the *Momordica balsamina* of botanists.

BALSAMINA (Rivinus). A genus of ten species of green-house annuals, chiefly natives of India. Linnæan class and order, *Pentandria Monogynia;* natural order, *Balsamineæ.* Generic character: calyx two-sepaled, deciduous; corolla four-petaled, unequal, the fifth abortive, two nearly united, the lower with a spur; anthers cohering, filaments short; stigma sitting, of five sides; capsule five-celled, five-valved, partitions thin; valves bursting by an elastic power, curling up; placenta like a central thread; tuberculis alternately seed-bearing. The common balsam, of which some account is given above, is the type of this genus, and was called *Impatiens* by Linnæus and others, but has been separated from the *Impatiens* family by Rivinus, a German botanist.

BALSAMINEÆ. Balsam family. A natural family of dicotyledonous plants, containing two genera and upwards of thirty species. The characters of the order are: sepals or phylla of the calyx five, irregular, deciduous, the two upper ones united together by their bases, the lower provided with a spur; petals four, hypogynous, united in pairs; five hypogynous stamens, with awl-shaped filaments and two-celled anthers; ovary single; stigmas divided into five parts; fruit capsular, with five elastic valves and five cells; seeds numerous, suspended.

This order has a great affinity to the geranium tribe, and is only distinguished from it by the spurred calyx, many-seeded fruit, and unsymmetrical flowers. In its flower it resembles the fumitory tribe, and in its seed-vessel, the wood-sorrel. The plants included in this order are chiefly succulent annuals, growing in moist situations, generally within the tropics. They are remarkable for the singularity and varied colouring of their flowers, as well as for the elastic force with which the valves of the capsules open and expel the seeds when ripe. They are propagated by seeds, and sometimes by cuttings.

Their properties are scarcely known, but they are looked upon as diuretic; some of them are said to be acrid.

The *Balsamina hortensis,* formerly *Impatiens balsamina,* or common garden balsam, was originally a native of the East Indies, but is now generally cultivated in Great Britain, on account of the beauty and showy appearance of its flowers. The numerous red and white varieties of this species which are met with in green-houses and drawing-rooms, must be familiar to every one. By care and proper cultivation, some balsams have been reared, four feet high, fifteen feet in circumference, and covered with large double flowers. The juice of the balsam, mixed with alum, is used by the Japanese to dye their nails red.

The *Impatiens noli-me-tangere,* yellow balsam, or Touch-me-not, is the only species of the order which is found native in Europe; it grows wild in several parts of England. It receives its name from the elasticity of its seed-vessel, which bursts, on the slightest touch, when the seeds are ripe. Its leaves are said to expand during the day, and to droop at night. Goats eat the plant, and a particular insect, the *sphinx elpenor,* lives on it. The *Impatiens biflora,* the American Touch-me-not, resembles the European species, but is handsomer. *Impatiens fruticosa* is remarkable, as being the only species which is not annual.

BALSAM OF CAPEVI (Linnæus). A genus of two species of South American trees; one of which is the *Copaifera officinalis* of botanists, producing the drug so called.

BALSAM PLANT. See POPLAR.

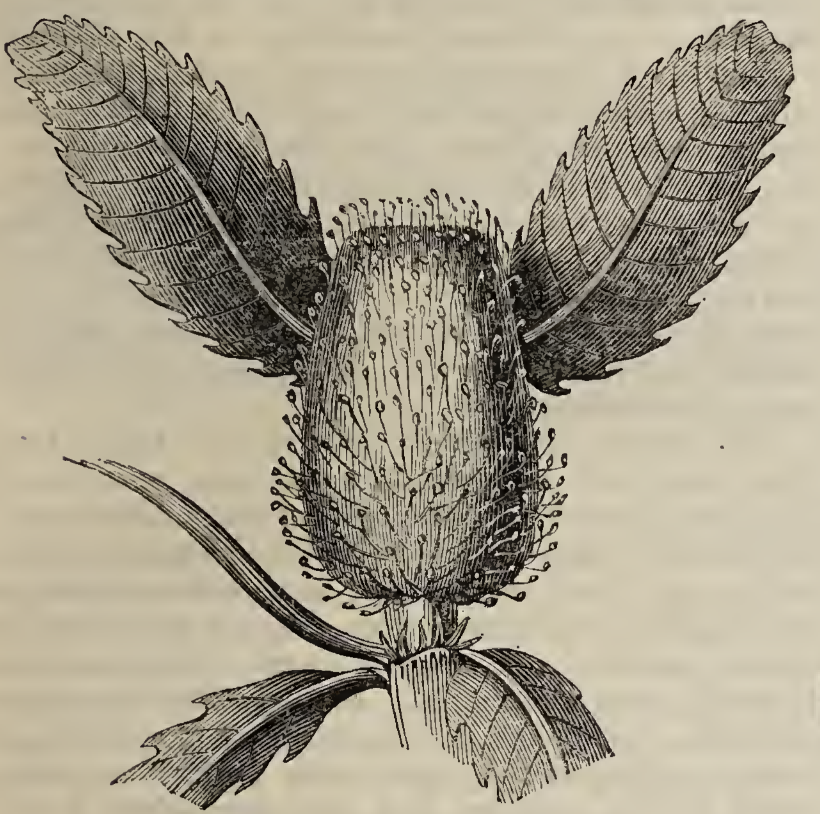
BAMBOO is the *Bambusa arundinacea* of botanists. It is a tree-grass, and one of the most useful vegetable productions in the countries where it is indigenous. Many stems rise, and continue to rise, closely together, from the same root. Their elegant jointed and tapering growth, to the height of forty or fifty feet; their regular form, high polish of the bark, toughness and durability of the wood, are circumstances which render the bamboo a most useful plant for the construction of huts, fences, household furniture, implements, and carriages; many kinds of vessels for liquids are made of the hollow stems. The young shoots are so succulent when they have just risen above ground, that they are cut like asparagus, and used as a pickle.

One of the species, the black bamboo, is often seen in Chinese scenery, and at a little distance has all the elegant pensile character of our weeping willow.

BAMBUSA (Schkuhr). A genus of eight species of shrubs and trees, natives of India. Linnæan class and order, *Hexandria Monogynia;* natural order, *Gramineæ.* Generic character: flowers in a spike or panicle, distinct, many flowered; inferior flowers hermaphrodite, upper ones males; calyx valves several, inner small, upper valves of the corollas are small likewise; corolla two valves, the lower one leathery, the upper membranaceous, margins turned inwards; squamæ, two below; style, bifid; caryopsis involved in the valves of the corolla. For some account of these trees, see article BAMBOO.

BANCHUS (Fabricius). A genus of hymenopterous insects, belonging to the *pupivora* and family *Ichneumonidæ*, or cuckoo-flies. The antennæ are long and thread-like, the abdomen is very much compressed at the extremity, and the ovipositor is not extended. Like the remainder of this great family, these insects are parasitic in the larva state, feeding upon the bodies of other insects. There are five British species, of which the *B. pictus* of Fabricius is the type.

BANKSIA (Robert Brown). A remarkable family of thirty-two species of Botany Bay plants, named in



Fruit and leaf of Banksia.

honour of the late sir Joseph Banks, president of the Royal Society. Linnæan class and order, *Tetrandria Monogynia;* natural order, *Proteaceæ*. Generic character: flowers in spikes, three single bracteated flowers, persisting; calyx four parted; stamens united to the top of the concavity of the calyx; squamæ four below the germen; folliculus woody, two seeded; seeds upper corner of winged. The great numbers and variety of this genus of plants, intermixed with thousands of others, which struck the view of Mr. Banks, Dr. Solander, and their companions, on their first landing in New Holland, under the guidance of the celebrated captain Cook, gave the name Botany Bay to that portion of the coast. The banksias, like a great majority of the plants from the same quarter, are as much unlike the plants of previously known parts of the world as are the distances between. Their physical habit, texture, and regular forms are only similar to a few found in southern Africa; but wholly different from the plants of the old world. Botany Bay is a source whence numerous new plants have been received, and a source which is not yet exhausted.

BARBADOES CHERRY. The genus *Malpighia* of Linnæus. There are twelve species, all stove evergreen shrubs. Class and order, *Decandria Trigynia;* natural order, *Malpighiaceæ*. Generic character: calyx, hemispherical, five cleft, bearing ten stipitate glands; corolla, five roundish petals, clawed, spreading; stamens below the germen; filaments cohering at the base; anthers roundish; style simple; stigmas capitate or like a nail; drupe tripyrena. This order of plants is generally handsome; and is known by their being furnished with stings upon their leaves, which causes a violent itching when applied to the naked hand.

BARBEL (*Barbus*, "bearded"). A genus of soft-finned fishes, with abdominal fins, belonging to the carp family, and having its name merely a contraction of "bearded carp." The generic characters are: the dorsal and anal fins short, a strong spine in the second or third ray of the dorsal, and four filaments of beard, one at each of the angles of the upper jaw, and two at the point of the muzzle. Barbel is a fresh-water fish, inhabiting the larger rivers of clear water, especially in stony places. In Europe they are not found in the very cold countries, as, for instance, in those to the northward of the Baltic; and in Britain they are found only in England. They are gregarious, are found inhabiting the same places in shoals, and are understood to be very voracious and indiscriminate in their feeding.

There is an ancient prejudice, that both the flesh and the roe of barbel are unwholesome, which Bloch found to be without foundation, by eating both without any bad consequences. The flesh is not, however, of very good flavour, neither is it understood to be very nutritious; and there is little doubt that, when out of season, that is, after spawning, it is not wholesome, as few fish are wholesome when in that condition. There are various species in the rivers of different parts of the world; and some of them, in their characters, approach the carp on the one hand, and the gudgeons on the other.

The common barbel (*Cyprinus barbus* of Linnæus) is the principal European species. It has the body and head both elongated, and the muzzle advanced considerably in front of the mouth, which gives that the appearance of opening on the under side. The upper jaw is strong, and tinged with red at the lip, as is also the under one. The two filaments of beard, which are dependent from the anterior part of the snout, are much smaller than those at the corners of the mouth. Each jaw is armed with ten teeth, placed in two rows, and recurved. The head is greyish olive, with some streaks of a yellowish tinge, extending from near the gape to the gill openings. The nostrils are placed near the eyes, and the last have the irides of a bright brown colour. The pectoral fins contain each seventeen rays, the ventral nine, the anal eight, the caudal nineteen, and the dorsal twelve, of which the third is armed with a spinous point. The pectoral, ventral, and anal fins are entirely of a reddish colour, rather paler at the base; the dorsal is reddish, with a portion at the base blue; and the caudal, which is forked, is bluish, with a portion at the base red. The back, which is rounded, is of an olive colour, passing into bluish toward the lateral line. Below that line the colour is yellowish, with a tinge of green, and the throat and belly are white. The lateral line is marked by a row of regular blackish spots, and the sides are bound obliquely with blackish brown, of greater or less brightness, according to the age and condition of the fish.

The favourite parts of the rivers for barbel are the currents of moderate rapidity which flow over gravelly bottoms, and especially among large stones. The fishes do not, unless when they are actively feeding, hold themselves in the stream, but rather lurk among the stones and under the banks. They are, however, easily brought out upon most occasions; but their most active time is, when moderate floods, which do not tinge the water too much, bring abundance of the substances on which they feed. The food which these floods bring them consists of snails, leeches, and other small animals, which are on these occasions either washed from the land, or lose the command of themselves in the water; and to these they have no objection to add the fry of other fishes, or indeed any living or recently dead animal which is small enough for their swallowing it. Some allege that they use their prominen snout for poking in the bottom of the water for food; but that is not very likely, neither is it very well ascertained.

Bloch mentions that they are fond of the flesh of the larger animals, and even of that of human beings. In corroboration of this, he mentions a feast of Turks and Turkish horses which the barbel of the Danube had, when, in 1683, the renowned John Sobieski of Poland raised the siege of Verona, which had been invested and all but taken by the Turkish army under Kara Mustapha. The valour with which Sobieski, with his Poles and Germans, set upon the Turks was somewhat unexpected; the rout was in consequence rapid and disorderly, and men and horses dashed or were driven pell-mell into the river. Their bodies, says the ichthyologist above-named, were in great part eaten by the barbel; and he adds: "*Avec un nourriture si variée, il n'est pas étonnant que le barbeau croisse fort vite*;" and unquestionably a much more formidable fish than a barbel might have grown very fat, if it had had a Turk and his horse every morning for breakfast.

There is only one objection to this story, and that is, it does not appear to be very possible. That a barbel, which is, as we have said, very indiscriminate in its feeding, will eat any animal which it can swallow, without inquiry as to whether it be beast or man, Turk or Christian, there is not the least doubt. But then, that a barbel could swallow a Turk and his horse, or any of the two singly, is rather too much for the reader to swallow; at least, if he swallow that, he may swallow any thing. Yet, if the barbel did not swallow the carcases upon that occasion, it is not easy to see how they could grow fast and fat upon them. The teeth of the barbel are not in any degree trenchant, so that it can neither bite nor masticate. The teeth, like those of most fishes, are merely prehensive; they catch food entire, but cannot divide it; and therefore, before John Sobieski could have fattened barbel for the epicures of Vienna with Turks and Turkish horses, he must have literally hewed them to mince meat before he drove them into the Danube. That the small animals upon which barbel feed should have attacked the dead bodies—that the barbel should have attacked them in return, and thus eaten the Turks and Turkish horses at second-hand—may have been true, because not impossible; but the eating of the Turks and horses at first-hand not being the one, could not be the other.

Barbel are ground or bottom fishes, and as such, they spawn in the warm season, and in the places which they inhabit. April or May, or even later in the season, according as the warm weather is longer in setting in, is the time for them. They are said not to be productive till four or five years old; and it is probable that the same individuals spawn only once in three or four years. There is no direct evidence of that being the fact, because we know very little of the habits of fish; and when we speak about their bringing forth their millions of young every year, we speak from what we know of land animals whose young are few. There is evident proof, however, of the fact, that, in those rivers where they abound, barbel may be had in season at all times of the year, though they are best about a month or six weeks before the time of spawning.

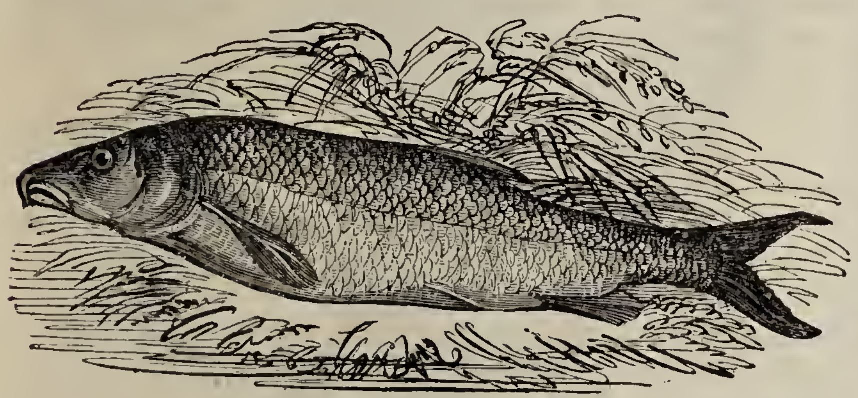
One must naturally suppose that the summer sun has much less influence upon barbel, and other bottom fishes, than upon those which come nearer to the surface—upon trout, for instance. Now, it is not clearly ascertained that trout spawn every season; and though they do, it certainly takes the whole action of the summer's heat to bring their roes and melts to maturity; for although, according to the different condition of the individuals, the operation extends over a considerable period, yet autumn is the average; and the eggs are placed in the shallows, so that they have the action of the sun early in the season. Barbel, on the other hand, deposit their eggs in the early part of the summer, and deposit them at the bottom. They are no doubt placed among stones or currents; but they are never placed where the water is very shallow, and it is not very well known at what period the young make their appearance.

The season of repose in barbel, or whether even they have such a season, has not been ascertained. Eels, which are much more ground fishes than barbel, hybernate by burying themselves in the mud, but eels are at all times mud-fishes; and, unless when, as passengers on their migrations, they are not found on those gravelly and stony bottoms which are the favourite resorts of barbel. But eels, like barbel, are much more abundant in temperate countries than in cold; and when they hybernate, they, if possible, resort to the estuaries, and bury themselves in the mud there.

The size which the barbel attains depends a good deal on the climate which they inhabit, and especially on the length and severity of the winter in that climate. They are said not to attain so large a size in the rivers of the north of Germany as in those of England; and not so large in England as in countries farther to the south. Three feet, and from fifteen to eighteen pounds weight, is a large barbel in England; but in the south of Europe they grow to the length of six feet, and are heavy in proportion. Like all the ground fishes, they are much more tenacious of life than those which inhabit nearer the surface; the action of their system appears to be slower, and their flesh is whiter. In these respects, however, they are inferior to the eel, though they approximate so far as to show that there is a diminution both in action and in the colour of the flesh, as well as more tenacity of life, in proportion as the fish inhabits at a greater depth in the water.

They are taken with nets, or with a line and barbed hook; and leeches, earth-worms, or small fishes, do for bait; they bite readily, and are in consequence easily caught. Bottom fishes, indeed, of all genera and species, bite more readily, are caught with more certainty, and appear to be much less capricious than those which inhabit nearer the surface, and sport and play in the water. But the probability is, that what we regard as the caprice of the latter, is their liability to atmospheric changes; from which the bottom fishes are defended by the deeper stratum of water which is habitually between them and the air.

Barbel, like eels, are very subject to intestinal worms, much more so than fishes which feed near the surface; and it is probable that the same extends to all or most of the bottom fishes. It does not appear, however, that, at any period of their history, the same mistake was fallen into in the case of the intestinal parasites of barbel as in those of eels. Subsequent inquiry has proved, what analogy pointed out, and inquiry would have showed at any time, if it had been made, that eels are spawning fishes, and remarkably prolific ones; but it was long said and written that they brought forth their young alive, and the worms were mistaken for the young. Barbel was always accounted a spawning fish. It is not one of the most prolific, neither is it one of the least so.



Barbel.

There are many species of barbel in the rivers, both of the eastern continent and the western. Some of the Italian species approximate to gudgeons, but retain the filaments at the mouth. There are one or two species in the Nile, and two or three in the Ganges; nor is there any doubt that, if sought for, they even would be found in most of the rivers of the warmer parts of the world. Their habits are, however, all nearly the same, so far as is known; and the chief distinctions are those of form, size, and colour, so that the description of one may in some measure serve as the description of all. They are nowhere first-rate or favourite fishes, and in some places they are despised, partly, no doubt, on account of the prejudice respecting their poisonous quality, but chiefly because the same rivers produce fishes of much better quality. See Cyprinoides.

BARBICORNIS (Godart). A very singular genus of butterflies, considered as belonging to the family of the *Polyommatidæ*, having the antennæ feathered throughout the whole length, and not clubbed at the tip. The genus consists of a single Brazilian species.

BARIDIUS (Schonherr). A genus of coleopterous insects, of the section *Tetramera* and family of the weevils. Schonherr enumerates fifty-two species, all of which are exotic.

BARIS (Germar). A genus of coleopterous insects, of the section *Tetramera*, and family of the weevils. They are of small size and reside in decaying wood; the fore-legs are inserted at some distance from each other, the antennæ are twelve-jointed. Curtis gives twelve British species, some of which, including the *Curculio lignarius* of Marsham, Mr. Stephens places it in the genus *Rhyncolus*.

BARK is the name given to the outer covering of trees and shrubs. This member of the stem is visible as soon as the plumelet escapes from the seed, and exists on the roots as well as on the stem; it is then called the cuticle, and ever after remains (on the generality of trees) on the exterior. Immediately beneath the cuticle there is a bed, or layer of greenish cellular matter, called *parenchyma*, and which, in the early stages of the growth of the tree, appears to be of much service in the conduction of the fluids of the system. The bark is thickened by new layers annually added to its inner surface, which layers are called *liber*, because, in the early ages of the world, it was used as a substitute for paper to write upon. In some instances these layers of liber are so distinct as to be easily separated from each other, and numbered, and by which the age of the tree may be known—a new bark being added in every year. The inner bark of many plants, as the lime, or linden tree, is made into packing mats; that of the *Laurus cinnamomum*, is the rich spice of commerce called cinnamon, and the whole bark of many trees, shrubs, and herbs, is useful either for the filaceous texture, or the concentrated qualities of the plant which it contains.

As the annual growth of the stem takes place within the bark, the first formed layers are consequently either stretched horizontally, as in the beech, or irregularly rent into vertical fractures, as is that of the oak. As the growth increases, the rents become wider and wider, and, on close inspection of the fractured parts, the annual growth may be distinctly seen. From the circumstance of many trees discharging their bark every third or fourth year, as the grapevine, the plane, *Arbutus Andrachne*, &c., and being rejected when useless by the oak, elm, &c., we may safely conclude that bark is an excrementitious member of a tree; each layer having only a temporary function, and which, when performed, is cast off, if not actually, at least virtually, from the living parts. Indeed, we know that, if not cast off, or rent, or sufficiently stretched to make room for the vital part within, it actually becomes a constrictive burden, insomuch that fertility ceases, health is injured, and the very life endangered. To save a tree so circumstanced, incisions should be made with the point of a pruning knife from the top to the bottom of the stem, quite through the bark; thus assisting nature, in her own way, to overcome an unnatural induration of the outer layers, caused, perhaps, in the first place, by an unusually warm summer. So well understood is this practical expedient in the culture of fruit trees, that old stunted individuals are sometimes entirely stripped of all their rough scabrous bark, to the manifest relief and renovation of the vigour of the tree. The last formed layer of liber is all that is absolutely necessary to be preserved in disbarking a hide-bound tree. Nor is any danger to be apprehended from such an expedient, unless it be performed in the winter, and on trees having a resinous or gummy sap.

The bark of some trees is remarkably thin, as the beech; others remarkably thick, as the cork tree. It is said that, in Spain, where the cork trees abound, they grow the better for being disbarked; and that, so quickly is the bark renewed, that it is, or may be, stripped off every seventh year.

Whatever may be the predominating quality of the tree or shrub, a considerable portion of it is generally found on the bark, and hence the many kinds of bark used in medicine and in the arts.

BARLERIA (Linnæus). A genus of twelve species of evergreen shrubs, natives of India. Linnæan class and order, *Didynamia angiospermia*; natural order, *Acanthaceæ*. Generic character: calyx, four parted, equal, the fourth segment often bifid; corolla, funnel shaped; limb five cleft, segments deeply cut; stamens, anthers oblong, erect; the lower ones frequently divided at the base; style protruding, filiform; stigmas thickish; capsule four angled, two celled, two seeded.

BARLEY is the *Hordeum vulgare* of botanists. Of this most useful plant eighteen species are described. Some of these are probably only varieties, because a plant so extensively cultivated, and one which has been for so long in use, must necessarily undergo changes, which, however physically different, may still be only variations. The most approved kind for the purposes of the maltster, distiller, miller, and farmer, now in cultivation, has the two opposite sides of the spike fertile, and the two intermediate ones sterile. This is a sign that the favourite sort is only a variety.

Cultivation.—Barley is the most tender of all kinds of corn; it requires a light, rich, warm soil. The land cannot be too fine for its reception, as it will not vegetate at all if laid among rough clods. Every care should be taken by means of the plough, harrows, and roller, to reduce the surface to the finest state possible; and though it may be reduced to the condition of dry dust, the seeds will rise more readily. The forwardness of the season, and particularly the dry mellowness of the soil, determines the time at which barley may be sown. Any time between the 1st of March and 1st of May is the usual seed-time. The ground should be rather too dry than too moist; and as soon as the furrow falls loosely from the plough, it is time to begin. Two ploughings may be necessary, and for this crop an extra ploughing had better be bestowed than that the seed be laid in roughly. It is not only necessary that every seed should vegetate, but that the whole should rise together. An even sample is always the most valuable, especially to the maltster; and this cannot be had unless the crop rise simultaneously, as nearly at least as the means and power employed will allow.

Barley is usually sowed after turnips. The ground having been fallowed and manured for this green crop, is in excellent order for barley when the turnips are off, as well in respect of richness as freedom from weeds, From two and a half to three bushels of seed are sowed to the acre, usually broad-cast, the surface being first harrowed down. Late sowed barley is sometimes ripe in nine weeks; early sowings require a longer time of course; and the crop is usually heavier, provided March and April have been favourable. Barley is either reaped, and bound into sheaves, or mowed with the sithe, and carried unbound to the barn. The produce is according to the quality of land and style of culture, and varies from three to six quarters per acre. Grass seeds are usually sown with barley, and as this rises, and is cut with the crop, if got up in a favourable time, it makes excellent winter fodder for live stock.

BARNARDIA (Lindley). A Chinese bulbous plant, introduced in 1819. Linnæan class and order, *Hexandria Monogynia;* natural order, *Asphodeleæ.* Generic character: corolla, six-petaled, spreading, persisting; stamens inserted into the base of the petals; filaments dilated at the base, fringed; anthers erect, oblong; style simple; germen three-celled, each cell one-seeded.

BARREN WORT. The *Epimedium Alpinum* of Linnæus. Class and order, *Tetrandria Monogynia;* natural order, *Berberideæ.* Generic character: calyx four-leaved; corolla four-petaled, with four pouch-like nectaries; stamens pressing on the style; pod oblong; seeds oblong, many. This plant has blood-red flowers, and is very rare in Britain.

BARRINGTONIA (Forster.) A beautiful tropical tree, very common on the islands in the Straits of Malacca. Linnæan class and order, *Diadelphia Pentandria;* natural order, *Myrtaceæ.* Generic character: calyx above, two-cleft, persisting; lobes obtuse, concave, leathery; corolla four large petals, thick and tough; stamens longer than the corolla, standing on a thickish ring; filaments like hairs; anthers roundish; style thread-like, embraced at bottom by a cup-like sheath; berry large, four-sided, and somewhat pyramidal, crowned with the calyx, one-celled; seeds pendulous, without albumen. This is a very ornamental evergreen tree; the foliage, flowers, and fruit are all large. The flowers are magnificent, and may be seen at the distance of half a mile from the tree.

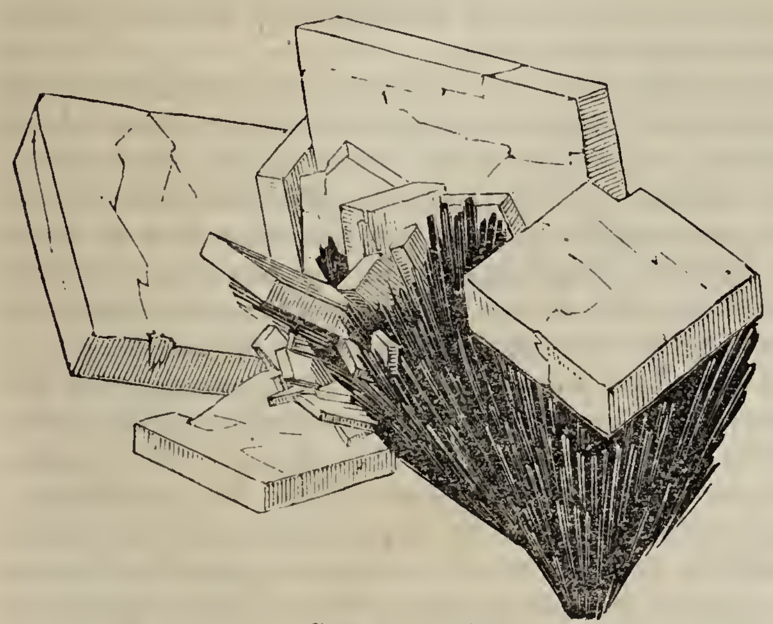
Barringtonia speciosa.—One-fifth the natural size.

BARTHOLINA (Robert Brown). A tuberous-rooted plant introduced from the Cape of Good Hope. Linnæan class and order, *Gynandria Monandria;* natural order, *Orchideæ.* Generic character: sepals gaping, connected interiorly with the base of the lip; labellum spurred, in three parts, multifid; retinaculo elongated, joined to the cup, glands distinct, exterior lobe half cut. This plant was formerly called *Arethusa pectinata,* by Linnæus.

BARTSIA (Linnæus). A genus of four species of annuals, three of them being indigenous to Britain. Linnæan class and order, *Didynamia angiospermia;* natural order, *Scrophularinæ.* Generic character: calyx tubular, edges four toothed, tips coloured; corolla gaping, upper lip erect, entire, concave; lower lip three lobed, a little reflexed, lobes equal; stamens under the upper lips; anthers incumbent, bifid behind; style with an incurved top; stigma headed; capsule compressed, two-celled, two-valved, dissepiment contrary to the valves; seeds oblong, ribbed. These plants resemble the common eyebright; and the *B. odontites* is easily mistaken for it.

BARYOSMA (Willdenow). A family consisting of six species, evergreen shrubs cultivated in the greenhouse; native country Cape of Good Hope. Linnæan class and order, *Pentandria Monogynia;* natural order, *Rutaceæ.* Generic character: calyx turbinated, unequally divided; the two upper segments like wings, the lower, smaller; standard erect, keel of two petals; pod thick, compressed, two-valved, one-seeded. These are ornamental plants, and nearly allied to *Diosma.*

BARYTES. A very heavy earthy mineral, which is not found pure in a natural state, but combined either with sulphuric acid, forming sulphate of barytes or heavy spar; or with carbonic acid, forming carbonate of barytes. Some of the salts of barytes are violent and certain poisons, destroying animals by inflaming the intestines, and are often used for the destruction of vermin.



Sparry Barytes.

The barytes, of which we give a representation in the above figure, is usually divided into a variety of sub-species, they are not, however, of sufficient general interest to be separately enumerated,

The radiated heavy spar is remarkably phosphorescent when heated. This property was first observed in the year 1630, by a shoemaker, named Vincenzo Casciarolo, during his search after the philosopher's stone. When the mineral is calcined, pulverised, and made into cakes, it acquires a strong phosphorescent property by exposure to light; the phosphorescence is visible, upon taking it into a dark place. When rendered phosphorescent it is known under the name of Bolognian phosphorus.

It may be proper to state that the columnar heavy spar has been frequently confounded with white-lead spar, but is distinguished from that mineral by the following characters: white lead spar has an adamantine lustre, its fracture is conchoidal, and its specific gravity rather more than six; whereas columnar heavy spar has a pearly lustre, distinct cleavage, and a specific gravity of less than five. See CELESTINE, STRONTIANITE, and WITHERITE.

BASALT. A term employed by geologists to describe a rocky compound, which furnishes some of the largest and most beautiful columnar masses which are to be found in the whole structure of our globe. Natural architectural edifices of this description are now existing, which far exceed in magnitude the Titan grandeur of Egyptian art; and it is gratifying to know that some of the most beautiful specimens of these temples, reared by the Creator as illustrations of his power, are found within the circle of the British isles. The singular tendency which basaltic formations evince to assume a columnar form, is familiar to the commonest observer: and no constituent material of the solid globe has more frequently been an object of geological speculation in recent times; theorists of nearly equal ingenuity having contended as vehemently for its igneous as its aqueous origin.

Although various parts of Europe and Asia abound with examples of basaltic columns, yet the island of Staffa and the Giant's Causeway appear to be the most extensive and striking in the known world. It is extraordinary that the former should scarcely have been known previous to the year 1772, when it was admirably described by sir Joseph Banks, on his visit to the Scottish Hebrides. The latter was better known by the previous description of the bishop of Ossory.

The island of Staffa will, in the first instance, engage our attention; and its extraordinary basaltic characteristics have been so accurately described by Dr. Macculloch as to render any further comment superfluous. The principal beauties of Staffa are to be found on its iron-bound coast, and our plate, BASALTES, will serve to convey a good notion of the character of one of its greatest basaltic ornaments.

If we commence with the landing place, the columns in this quarter are placed in the most irregular directions, being oblique, erect, horizontal, and sometimes curved; while they are also far less decided in their forms than the larger vertical ones which constitute the great face. When they reach the grassy surface of the island, they gradually disappear; but are sometimes laid bare, so as to present the appearance of a geometrical pavement, where their ends are to be seen; in other places displaying portions of their parallel sides.

At the Scallop, or Clamshell Cave, the columns on one side are bent, so as to form a series of ribs not unlike an inside view of the timbers of a ship. The opposite wall is formed by the ends of columns, bearing a general resemblance to the surface of a honeycomb. This cave is thirty feet in height, and sixteen or eighteen in breadth at the entrance: its length being 130 feet, and the lateral dimensions gradually contracting to its termination. The inside is uninteresting. The noted rock Buachaille, or the herdsman, is a coniadal pile of columns, about thirty feet high, lying on a bed of curved horizontal ones, visible only at low-water. The causeway here presents an extensive surface, which terminates in a long projecting point at the eastern side of the great cave. It is formed of the broken ends of columns, once continuous to the height of the cliffs. This alone exceeds the Giant's Causeway, as well in dimensions as in the picturesque diversity of its surface; but it is almost neglected among the more striking and splendid objects by which it is accompanied. The great face is formed of three distinct beds of rock, of unequal thickness, inclined towards the east at an angle of about nine degrees. The lowest is a rude trap tufa, the middle one is divided into columns placed vertically to the planes of the bed, and the uppermost is an irregular mixture of small columns and shapeless rock. The thickness of the lowest bed at the western side is about fifty feet; but, in consequence of the inclination, it disappears under the sea, not far westward of the great cave. The columnar bed is of unequal depth; being only thirty-six feet at the western side, and fifty-four where the water first prevents its foundation from being further seen. To the eastward its thickness is concealed by the causeway. Thus, at the entrance of the Great Cave on this side, the columns are only eighteen feet high, becoming gradually reduced to two or three, till they disappear. The inequality of the upper bed produces the irregular outline of the island. The inclination of the columns to the horizon, in consequence of their vertical position towards the inclined plane of the bed, produces a very unpleasing effect whenever it is seen from the south-west: the inclination of nine degrees conveying the impression of a fabric tottering, and about to fall. Fortunately, the most numerous and interesting views are found in positions into which this defect does not intrude; and many persons have doubtless visited Staffa without discovering it. Although the columns have a general air of straightness and parallelism, no one is perfectly straight or regular; in this respect they fall far short of the Giant's Causeway. Very often they have no joints; sometimes one or more may be seen in a long column; while, in other places, they are not only divided into numerous parts, but the angles of contact are notched. They are sometimes also split by oblique fissures, which detract much from the regularity of their aspect. These joints are very abundant in the columns that form the interior sides of the Great Cave, to which, indeed, they are chiefly limited; and it is evident that the action of the sea, by undermining these jointed columns, has thus produced the excavation: as a continuation of the same process may hereafter increase its dimensions. The average diameter is about two feet; but they sometimes attain to four. Hexagonal and pentagonal forms are predominant; but they are intermixed with figures of three, four, and more sides, extending even as far as to eight or nine, but rarely reaching ten. It is with the morning sun only that the great face of Staffa can be seen to perfection. As the general surface is undulating and uneven, great masses of light or shadow are thus produced, so as to relieve that, which, in a direct light, appears a flat insipid mass of straight wall. These breadths are further varied by secondary shadows and reflections arising from smaller irregularities; while the partial clustering of the columns produce a number of subsidiary groups, which are not only highly beautiful, both in themselves and as they combine with and melt into the larger masses, but which entirely remove that dryness and formality which is produced by the incessant repetition of vertical lines and equal members.

The Cormorant's or M'Kinnon's cave, though little visited, in consequence of the frauds and indolence of the boatmen, is easy of access, and terminates in a gravelly beach, where a boat may be drawn up. The broad black shadow, produced by the great size of the aperture, gives a very powerful effect to all those views of the point of the island into which it enters; and is no less effective on land, by relieving the minute ornaments of the columns that cover it. The height of the entrance is fifty feet, and the breadth forty-eight; the interior dimensions being nearly the same to the end, and the length 224 feet. As it is excavated in the lowest stratum, the walls and the ceiling are without ornament; yet it is striking from the regularity and simplicity of its form. But the superior part of the front consists of a complicated range of columns, hollowed into a concave recess above the opening; the upper part of this colonnade overhanging the concavity, and forming a sort of geometric ceiling; while the inferior part is thrown into a kind of secondary mass of broad but ornamental shadow, which conduces much to the general effect of the whole. The Boat Cave is accessible only by sea. It is a long opening, resembling the gallery of a mine, excavated in the lowest rude stratum; its height being about sixteen feet, its breadth twelve, and its depth about 150 feet. Upwards the columns overhang it, so as to produce a shadow, which adds much to the effect; while they retire in a concave sweep, which is also overhung by the upper mass of cliff, thus producing a breadth of shade, finely softening into a full light by a succession of smaller shadows and reflections, arising from the irregular groupings of the columns. The upper part of this recess, catching a stronger shadow, adds much to the composition; while the eye of the picture is found in the intense darkness of the aperture beneath, which gives tone to the whole.

The Great Cave is deficient in that symmetry of position with respect to the face of the island which conduces so much to the effect of the Boat Cave. The outline of the aperture, perpendicular at the sides, and terminating in a contracted arch, is pleasing and elegant. The height, from the top of the arch to that of the cliff above, is thirty feet; and, from the former to the surface of the water at mean tide, sixty-six feet. The pillars by which it is bounded on the western side, are thirty-six feet high; while, at the eastern, they are only eighteen, though their upper ends are nearly in the same line. This difference arises from the height of the broken columns which here form the causeway; a feature which conduces so much to the picturesque effect of the whole, by affording a solid mass of dark foreground. Towards the west the height of the columns gradually increases as they recede from the cave, but their extreme altitude is only fifty-four feet, even at low water. The breadth of this cave at the entrance is forty-two feet, as nearly as that can be ascertained, where there is no very precise point to measure from. This continues to within a small distance from the inner extremity, when it is reduced to twenty-two; and the total length is 227 feet. The finest views here are obtained from the end of the causeway, at low water. When the tide is full, it is impossible to comprehend the whole conveniently by the eye. From this position also the front forms a solid mass of a very symmetrical form; supporting, by the breadth of its surface, the vacant shadow of the cave itself. Here also, that intricate play of light, shadow, and reflection, which is produced by the broken columns retiring in ranges gradually diminishing, is distinctly seen; while the causeway itself forms a foreground no less important than it is rendered beautiful by the inequalities and the groupings of the broken columns. Other views of the opening of this cave, scarcely less picturesque, may be procured from the western smaller causeway; nor indeed, without bestowing much time and study on this spot, is it possible to acquire or convey any notion of the grandeur and variety which it contains.

The opposite points of Scotland and Ireland on the Antrim coast correspond exactly in geological structure. Of the basaltic group of hills in Ireland, Knocklead, in the northern extremity of the eastern chain, offers the highest summit, rising 1820 feet above the level of the sea; but its basis is occupied to the height of 500 feet by primitive rocks, leaving 1320 feet for the thickness of the overlying strata. Divis Hill, near the southern extremity of the chain, is wholly composed of these strata, and attains an elevation of 1475 feet above the level of the sea. Cragnashoack, at the southern extremity of the western chain, has a height of 1864 feet. The basaltic covering seems to acquire its greatest thickness on the north, where the basaltic cap of Benyavenagh, the most northern summit of the western chain, measures more than 900 feet. The average depth of the basaltic superstructure may be safely estimated at 545 feet, and its superficial extent at the prodigious area of 800 square miles.

The Giant's Causeway consists of three piers or moles, projecting from the base of a stratified cliff, about 400 feet in height: the principal mole is visible, for about 300 yards in extent, at low water, the others not more than half that distance. It is composed of polygonal pillars, of dark-coloured basalt, so closely united, that it is difficult to insert more than a knife-blade between them ; and the formation of a continuous surface at each point in the pavement, by polygons, whose angles vary considerably. Towards the centre of the whole mass the pillars ascend ; and, from the peculiar appearance of the surface, this vertex is usually called the Honeycomb. The pillars are irregular prisms of an uncertain number of sides, varying from three to nine : there is one of three sides near the centre of the Honeycomb, and several of nine have been detected, but the hexagonal form prevails most generally.

Each pillar is in itself a distinct piece of workmanship ; it is separable from all the adjacent columns, and then is itself separable into distinct joints, whose articulation is as perfect as human exertion could have formed them, the extremities of each joint being concave or convex, which is determined by the terminations of the joints with which it was united. But there is no regularity as to the upper or lower extremity being concave or convex ; the only law on this point is, that the contiguous joints are, the one concave, the other convex. In order to secure stability to this piece of architecture, the angles of the inferior joints frequently overlap those of the superior so closely that the force required to dislocate them occasionally fractures the joints. The geological scenery east of the causeway is truly sublime : the dark precipitous cliffs, which rise regularly in gradually retiring strata, certainly suggests the idea of their having been deposited age after age, as Werner thought ; and the extraordinary appearance of the various colonnades might, for a moment, seduce the fancy of the visiter, and lead him to imagine that here whole palaces had been overwhelmed in ruin. These successive capes, which are visible from the causeway, are but a part of one great headland, called Benmore, the rival of Benmore or Fair-Head, and all of them similarly formed. As an illustration of this part of the basaltic coast of Antrim, we may take a graphic sketch from the very remarkable detached mass of Carrick-a-Rede.

Carrick-a-Rede.

The island is nearly of the same elevation as the adjacent mainland, rising about 350 feet from the surface of the ocean ; and in the adjacent cliffs is a very beautiful cave, about thirty feet in height, formed entirely of columnar basalt, of which the bases appear to have been removed, so that the unsupported polygonal columns compose the cave. Carrick-a-Rede is separated from the coast by a chasm of sixty feet in breadth. Vast iron rings are morticed into the rocks on each side, to which are fastened two ropes running parallel to each other, connected together with cross bars of rope at equal distances. A series of planks are added ; and over this species of primeval bridge, men, women, and children, are daily in the habit of passing to the basaltic mass.

Of the nature of the several mineral productions to be found about the Causeway it may be said, that where the basalt is not formed into columns, the masses possess a considerable variety of texture as well as colour ; in colour, they are to be found from various shades of grey and brown to a dull red. All these varieties are attributable to the iron contained in the mass under various circumstances of chemical influence. The basalt often approaches in its general character to amygdaloid, the cavities being sometimes very considerable, and either coated or filled entirely with various minerals. In the former instance, the interior surfaces have always a crystalline character, which, when entire, not uncommonly constitutes a hollow sphere, to which the name of Geode has been applied. This is principally the case with such as are of a siliceous nature. Zeolite occurs here in every known variety ; and that which is usually termed fibrous, or mealy zeolite, is particularly deserving of attention, from its extreme delicacy and brilliancy of character, resembling the fine down of a thistle. Calcareous spar is exceedingly common ; steatite and green earth are occasionally found ; chalcedony, approaching to opal, and agates, are not rare. On the side of Mount Pleaskin, or Placekin, near the Giant's Causeway, there is a remarkable appearance of imperfect crystallisation between the principal ranges of pillars, much resembling the diverging figure of radiated zeolite. The varieties of zeolite are well known to abound in basaltic regions, particularly the most northern, and that alluded to impresses the idea of a rapid crystalline process. Intense cold and frost most frequently produce a figure more or less resembling it.

On the islands of Staffa and Rathlin, curvilinear prisms of basalt present themselves, which, as we have already stated, much resemble the ribs of a ship. Near the Cascade of Vestena, in the territory of Verona, where a similar appearance exists, irregular aggregated bodies (some approaching to a sphere and some to an imperfect prism) rest within the uppermost segment of the circle. The influence of the laminated sphere seems no less applicable to the various degrees of inclination exhibited by basaltic columns in several other parts of the world.

Great quantities of basalt are likewise found in the vicinity of Mount Etna in Sicily, of Hecla in Iceland, and of the volcano in the isle of Bourbon. These three are the only active volcanoes in whose neighbourhood it is to be met with ; but it is found adjacent to many which are extinct, particularly the silent craters of Italy.

The rocks of the Cyclops, in the neighbourhood of Etna, exhibit magnificent basaltic columns, which at first view greatly resemble the Causeway pillars ; but on a closer inspection, a very remarkable difference will be found to exist. The cyclopian pillars are divided into distinct families or groups, of six or seven in number, assembled round a larger and central column, which they appear to be connected with; while the causeway pillars are not observed to respect any point or centre, but are each independent and complete. The basalts of these rocks also abound in small crystals, not unlike rock crystal, but much softer, and which yield to the action of the air.

The promontory of Castel d'Iaci, which terminates the basis of Etna, is almost entirely composed of basalts; but of a different kind from what has been just described. It consists of a number of cylinders, whose diameters vary from six inches to twenty feet. Some of these are solid, others hollow like a cannon; some extended in layers, others compressed like rolls of tobacco, some are like globes inclosed in the rocks, while others are bent in a variety of forms.

A general view of the various theories illustrative of the origin of basaltic formations, will be given under the head of TRAP-ROCKS, called by geologists "unstratified superjacent;" and we must content ourselves, in the present place, with briefly adverting to one or two hypotheses, which are essential to the illustration of our present article. Mr. Hare, who devoted a considerable deal of science and industry to an examination of the Antrim formations, says, that where basalt does not divide itself precisely after the manner of prismatic columns, or evince a tendency to that figure on a great and general scale, it often forms laminated spheroidal bodies, which, varying in their diameters, constitute, by aggregation, rocks of considerable magnitude.

The latter circumstance, in addition to the occurrence of basaltic fragments, in which a sphere appears to be enveloped by a polyhedral figure, suggested the idea that a compressible laminated sphere must be the primitive figure of each prismatic articulation, composing a common basalt; and that the lateral plane surfaces, as well as the corresponding concavity and convexity of the horizontal surfaces, the trihedral processes of the lateral edges, and the corresponding truncations of the superimposed joint, result from the assemblage of spheres under the influence of gravitation while the component particles are in a yielding state; their laminated structure being a mechanical accommodation to the filling of those interstitial spaces, which must result from an aggregation of spheres.

Basaltic Columns.

These ideas may be in some degree elucidated by the accompanying engraving, in which the first figure represents a basaltic fragment from the vicinity of Belfast, where the sphere is developed by a partial decomposition of the prism; while the group shows the prevailing character of basaltic columns in general, two of the constituent prisms being detached, to show the alternate concavity and convexity of the horizontal surfaces, with the angular surfaces and truncations of their edges.

The Rev. William Conybeare thus describes his view of the basaltic formations:—"I would observe, then, that this formation is distinguished by characters so directly opposed to those which all rocks undoubtedly of aqueous origin possess, that no hypothesis which ascribes both to a common origin, can be otherwise than contradictory, and at variance with itself. For,

"1. Of all other formations, the least ancient are the least elevated; but this, the most recent of all, yet rivals the primitive mountains in height.

"2. Of all other formations, the degree of consolidation decreases together with their age, their texture passing from crystalline through the several gradations of sub-crystalline, compact, coarse, and lastly earthy; while in this formation, even where it rests on chalk, the crystalline texture of the oldest rocks frequently occurs.

"Whin dykes, which are indisputably connected with this formation, differ from all other mineral veins in the circumstance of their traversing all rocks indifferently; while of other veins, particular classes are exclusively associated with particular rocks. Such being the negative evidence against the Neptunian hypothesis, I proceed to that which is positive in favour of the Volcanists; as,

"1. The identity of chemical composition in basalt and lava.

"2. The constant occurrence of trap-rocks in volcanic districts.

"3. The confessions of the Wernerians themselves, that the basalt of Auvergne is one of igneous origin.

"4. The testimony of those best acquainted with districts still exhibiting active volcanoes. Such persons as Dolomieu and Spallanzani, have uniformly maintained the igneous origin of basalt, while those who have contended against it, have generally been practically unacquainted with countries of this description."

Whether, with the above distinguished geologist, we regard the basaltic masses we have described, as of igneous formation—relics of those tremendous volcanic operations which shook the whole world, and ultimately, by breaking up the foundations of the great deep, assisted in producing the deluge recorded in Holy Writ; or, whether we adopt the less assuming theory of an aqueous origin, the contemplative philosopher must see in their exquisite symmetry of arrangement and magnificence of architectural proportion, a new cause for reverential gratitude to the great Architect of all things.

> Who not content
> With every good of life to nourish man,
> By kind illusions of the wondering sense,
> Hath made all nature beauty to the eye,
> And music to the ear.

BASIL. The *Ocymum basilicum* of Linnæus. This is an extremely sweet-scented garden pot-herb, and being an annual is sowed every year on a warm border, thinned and kept clean, is ready for gathering when in flower, and then, gradually dried, is tied in small bundles and hung up in a dry room for use.

BASILISCUS (basilisk lizard). A genus of Saurian reptiles of very harmless character, though by some means or other inheriting a most formidable name. The application of the fabled names of antiquity, such as the cockatrice, the dragon, and the basilisk, to the realities of modern natural history is not only absurd, but must in some instances be attended with bad consequences. Men read with horror, in their boyish days, of the terrible powers of dragons, and the deadly venom of cockatrices and basilisks,—venom so deadly, that it not only killed all else upon which the terrible creatures looked, but if they happened to meet the reflection of their own withering glances from a mirror or a pool of water, they could not escape the death-stroke of their own looks. These terrific qualities make a deep impression upon the youthful mind; and as the name is the index to all the terrors, the repetition of it naturally suggests them. Thus there must be a most curious conflict between memory and present perception, when the dragon is found to be a creature that can hurt nothing stronger than a fly, or that the basilisk is a harmless and pretty little creature—for although peculiar in shape it is pretty—that lives upon small vegetable seeds, and neither hurts nor is capable of hurting a single living creature. The reality which addresses itself immediately to the senses must, in the end, get the victory, how hard soever the impression on the memory may plead. Thus the fable is discarded, and takes along with it all which it in any way holds linked by association. The school and scholarship, and all that is connected either with the one or the other, come in for their share of the doubt, disbelief, and derision; and that which, but for the discovery, would have continued to afford excitement, and therefore pleasure, becomes the foundation of self-humiliation and reproach. Either, therefore, the fable should be given up, or the name which turns it into a mockery should cease to be used. The fable has its use in attracting the mind, at an age at which it could not be attracted by reality. Boyhood, when the hopes are full of the joys of years unborn, is a time of romance, and all the Utilitarians that ever lectured will never make it otherwise. And it is well for us that they cannot; for the reality of life is the painful portion of it, and the romance the pleasurable. Not only so, but that which utilitarians call the reality is the sensual, the animal, the material part of life; and the romance is the mental or intellectual part. If the former is made the sole object of consideration, then the result is misery in the present life and no hope hereafter. There is consequently an immediate and utter extinction of all that is pleasant in life—of all that is endearing in society; because there remains no value but *money* value; and "Thy money perish with thee" is the denunciation, which takes effect both here and hereafter.

We are not pleading for fables, or attempting to recommend that which is not true at the expense of the truth. But in "the youth of life," it is vain to refer to that which in after life is called "utility," as the only or the chief incentive to study. You cannot, at every step of a boy's education, draw his attention to his book, or his other study, by the allurement of "the price that it will bring him in;" and if you could, what a mean and sordid creature, nay, what an immoral and dishonest creature you would make of him! If we labour to impress upon the young mind, the idea that there is no value but in possessions, and no reward but in pecuniary payment, we absolutely, in express terms, teach fraud and theft, destroy all the better feelings of the heart, and make man no better than a beast. We take the very worst view of the worst conduct of human beings as the foundation of character; and then we need not wonder that our pupil ripens into crime, and as the law is not abolished, the feeling which we thus inculcate, that law and justice are evils, because restraints upon *utility*, renders him obnoxious to punishment. Little romantic extravagancies appear to be as necessary for young minds as they are for young nations—among which they have ever been found; and though they are only "play" in after life, both with the one and the other, yet the period when they cease altogether is the dotage of senility—the sad condition from which earthly hope has for ever departed.

It is, therefore, always to be regretted when the reality spoils a fable which gives pleasure; and the instructor who preaches truth in this wise, is exactly the counterpart of him who should go about to make a man zealous and enterprising in his business, by disclosing to him at the outset, all the failures, impositions, frauds, and misfortunes, to which he should be subjected in the course of it.

Applying the fabulous names of the ancients to the real productions of nature, is but one form of this mode of making knowledge the destroyer of happiness; but it is one which brings no good to compensate the evil. It destroys the marvel of the boy, but enough of that marvel remains to turn into ridicule and contempt the knowledge of the man. The withering power with which the eyes of the fabled basilisk were endowed, gives point to some of the choicest passages in poetry, and to persons of fine feelings these passages give more abundant and exquisite pleasure than they could purchase in the 'market,' even if they had the wealth of the Indies to lay out in the purchase of it. Now, if along with these passages there come always the conviction that the said basilisk is equally frail and harmless as a butterfly among the flowers, there remains no more pleasure,—derision, contempt, is the natural feeling. It is of no use to plead that it is a different basilisk altogether, for there is identity in the name; and if the fabled name has been bestowed upon a reality which has not the attributes of the fable, then the bestower of that name has been guilty of a falsehood.

Any one who wishes to judge how much of poetic enjoyment may and must be destroyed by this misappropriation of names that had their meaning before, may turn to the second scene of Richard III., and read on to this line, spoken by Lady Anne:—

> "Would they were *basilisks*, to strike thee dead!"

Substitute the word "butterflies" for "basilisks;" read the line thus:—

> "Would they were *butterflies*, to strike thee dead!"

and then feel the power of the scene if you can.

Yet the butterfly of natural history is quite as likely to strike one dead as the natural history basilisk; and thus while the application of the fabled name destroys the force of the fable, the memory of the fable turns the real animal into ridicule. The application of sounding names, where there is no analogy to warrant their use, has done much mischief in all the departments of natural history, and also in all the other subjects from which these names are taken.

The basilisk of antiquity (and it was gravely described by Pliny and Galen among the ancients, and has been so by Lobo, Prosper Alpini, and Aldrovandi, among the moderns) was a terrible creature. Among the pools and lakes of that land of marvels which gave source to the mighty flood of the Nile, it reigned in terrible majesty; but it reigned in desolation. Its name was derived from the Greek word βασιλιζομαι, "to reign." It had eight feet, two large scales for wings, was of a golden yellow, and its head

"The likeness of a kingly crown had on."

The taint which it communicated to the air was more deadly than that fabled of the upas tree, and believed by Dr. Darwin (though the Doctor was rather a sceptic in some other matters, the proofs of which were open to him); for no animal could breathe the same air and live, and its glance was instant death, even to the lion himself. Nature could not, of course. form such a creature in the ordinary way; but, like the cockatrice—the dread of which has, perhaps, not yet altogether ceased in this country—it was hatched by a serpent out of the egg of a cock!

Though adopted by the naturalists above mentioned in the plenitude of their credulity, and continued by their copyists, the basilisk of the ancients was purely a poetical creation—the emblem of regal tyranny, in short; and its origin was made unnatural, and the scene of its dominion laid in the desert, because to have spoken more plainly at home might not have been altogether safe. It does not follow, however, that the ancient poet who imagined the fable believed in the material existence of the basilisk, any more than Milton did in that of his personifications of Sin and Death, or Shakspeare in those ghosts which he conjured up with such matchless skill, and upon which the poetic beauty and the moral grandeur of some of his best passages are made so much to depend.

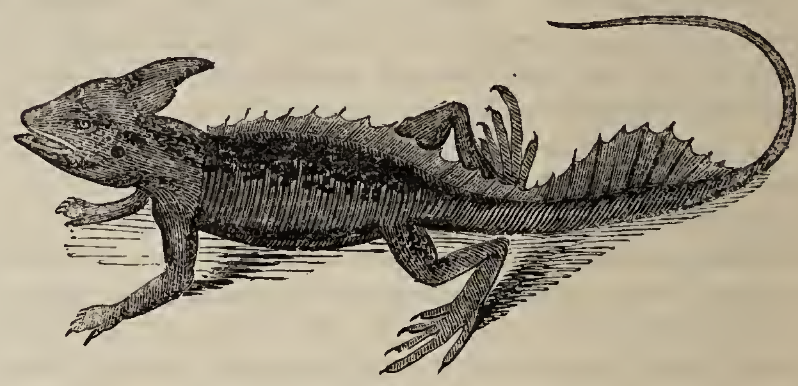
We have deemed it advisable to notice, in this the first striking instance of it which has occurred in the regular order of the alphabet, the prostitution of poetic or allegorical names to subjects in natural history; and having done so once for all, we shall shortly notice those basilisks which come more properly within the scope of our pages.

Basiliscus is a genus of the lizard family, and the characters are—the body rather thicker in proportion to its length than in most of the order; the head short, and rather pear-shaped; the legs thick and strong, with five toes, armed with a claw on each foot; and the tail very long, and compressed or flattened laterally. The back and upper part of the tail are furnished with a crest, supported on rays something resembling those of the fin of a fish, and capable of being folded or expanded. The rays of this crest are articulated to the spinous processes of the vertebræ. The whole surface, including that of the dorsal crest, is covered with small imbricated scales of a rhomboidal form; but there are no pores on the inner sides of the thighs. The tongue is broad and fleshy, and not protrusile, but rather united to the under-jaw for the greater part of its length. There are small teeth both in the palate and the jaws.

The structure of the mouth shows that these animals do not lie in wait for their food, but go in quest of it. They are nimble and lively, as well as harmless and gentle. They jump with much agility from branch to branch, in which they are assisted by the dorsal crest, and probably also by the inflation of the throat, which they have the power of doing at pleasure. Some of the accounts state that they can fly, but that is a mistake. They leap far, but they have no means of giving themselves a fresh impulse when in the air, which is the essential operation in flying. It is probable that they can swim, and that they then use the crest on the tail in the same way as a fin. But their habitation is on the dry land and in the forests, to which their lively motions give a cheerful air.

There are two known species, the one an American and the other an Asiatic, but the places where they are found are local, and bear some resemblance to each other.

The Mitred Basilisk (*Basiliscus mitratus*) is the American species, and the following figure will give a general notion of its form.



Mitred Basilisk.

This species has a long mitre-shaped crest on the back part of the head, from which it gets the specific name, and probably the generic one was given on account of the same; but it is not generally accurate, as the Asiatic species has no crest. The crest is membranous, with a cartilaginous support. This species is of considerable size; its general colour is blue, with one white band behind the eyes, and another behind the gape, the last with points inclining to the shoulders.

The Amboyna Basilisk (*Basiliscus Amboinensis*) differs from the former chiefly in wanting the mitre-shaped crest on the head, and having that on the back and tail pectinated or toothed like a comb; the tail also is less pointed than in the American species.

These harmless and lively little creatures are natives of those parts of the several continents which receive the trade winds [see the article Atmosphere]; and are, in consequence, not only abundant in all kinds of life, but have more variety both of plants and of animals, and more species which are peculiar and unknown in any other region than any other portions of the globe. The north-east coast of South America, and the south-east of Asia, and particularly Guiana and the lower part of the valley of the Amazon in the former, and the Oriental islands in the latter.

The vegetation which the peculiar climates of these lands, the most highly favoured by nature on the whole surface of the globe, furnish as the foundation of support for all the varied living tribes in which they abound, is not a mere carpeting—a surface vegetation, such as we find in the meadows of the more temperate lands: it is a forest vegetation, one in which many races of animals can take up their abodes in the same trees, the one race inhabiting above the other—some among the roots of the trees, some on the stems, and so on till we come to those that inhabit the small twigs at the very top. All classes of animals are found there; but the peculiar inhabitants are chiefly climbers,—climbing mammalia, climbing birds, and climbing reptiles. The first of these have not much beauty to boast of; but in colour the second and the third are among the gayest of nature's living productions. The ground reptiles, the serpents, and the frog tribe, which live under the shadow of those thick and perennial forests, are seldom beautiful, and the former are often poisonous; but the tree saurians rival the birds in the brilliancy of their tints; and in the more lively ones, among which may be counted the basilisks, it is not very easy to distinguish reptile from bird when they are in motion among the trees.

BASSIA (Linnæus). A genus of three species of East Indian trees. Linnæan class and order, *Dodecandria Monogynia;* natural order, *Sapoteæ.* Generic character: calyx of three sepals, leathery, persisting; corolla bell-shaped, tube swollen; limb eight parted, erect; stamens inserted on the tube of the corolla; anthers linear, arrow-shaped, hairy within; style awl-shaped, longer than the corolla; berry fleshy, five-celled; cells one-seeded. The *Bassia butyracea* is celebrated for yielding a great quantity of useful oil from its seeds.

BASSUS (Fabricius). A genus of hymenopterous insects belonging to the division *Pupivora* and family of the cuckoo flies, *Ichneumonidæ.* As originally constituted, the genus contained insects of different genera, and Mr. Curtis has much increased the confusion by figuring one of the *Ichneumones adsciti*, the *Diplozon calculatorius* as a Bassus. As defined in Gravenhorst's great work upon this family, it is distinguished by the abdomen being depressed and sessile with the first joint flat, and comprises thirty-five species, and three sub-genera. The species are all parasitic upon other insects.

BASTARD TOAD-FLAX. The *Thesium linophyllum* of Linnæus. Class and order, *Pentandria Monogynia;* natural order, *Santalaceæ.* Generic character: calyx five cleft, with intermediate notches; corolla none; style cloven; drupe crowned by the calyx. There are six species of this family, all, except one from the Cape of Good Hope, herbaceous. One is found in England, on high open chalky pastures.

BATRACHIA (frogs and frog-like animals). An order of reptiles, the last of the class in Cuvier's arrangement of the animal kingdom; and very properly so placed, as they may be considered as the connecting link between the other vertebrated animals and fishes. This is not to be taken so much from the haunts of the animals as from their structure. They are indeed all more or less aquatic; and if they do not live actually in the water, they are found only or chiefly in moist places, and they come most abroad in humid states of the atmosphere. There are aquatic animals of all the vertebrated classes; and many of the others live more habitually in the water than some of the batrachia; but the organisation of the batrachia approaches more nearly to that of fishes, than even the organisation of the water tortoises.

There is one habit which may be considered as the sign of this organisation. All the birds and other reptiles which inhabit the waters are produced upon the land. In the breeding season the parents seek the shores and banks, and deposit their eggs there to be hatched by the action of the dry atmosphere. They even, in general, protect them from the moisture of the atmosphere—the rain and the dew. The eggs even of the most aquatic bird—of those species which cannot fly, and which walk with great difficulty, and may therefore be said to have no element but the water, would be rendered abortive if they continued wetted even for a very short time. It is probable that the eggs of the other aquatic reptiles would suffer from the same cause; for though these animals do not incubate, or sit upon their eggs like birds, yet they deposit them in holes of dry banks, or in the beach above flood-mark, and carefully cover them up from the weather. The batrachia take no such precautions, or, to speak more in accordance with the facts, they do not require the heat or the protection to bring them to maturity.

It is a universal law, holding not merely in the operations of nature, but in the works of man—even in his mental exertions—a law to which there is not one exception—that, if the work is done with equal skill, the result—the superiority, or perfection, or at all events, the elaborateness of that which is produced, is always in proportion to the quantity of labour bestowed upon it, estimating that labour both in energy and in time. This is a most important principle in the study of natural history, because of its perfect universality; and we can apply it better in natural history than in human action, because nature's workings, as far as they go, are all equally skilful.

Now we find a very striking difference in the apparent care with which the young of different races of animals are brought to maturity. Those of the perfect mammalia are cherished and defended in the internal matrix—defended from all action of the weather, and enjoying the temperature of the mother, till they are fully formed. But even among these there are considerable differences;—as the kid bounds and the lamb sports almost the instant of birth; while the young of the carnivora are dropped blind, and remain utterly helpless for some time. The young of the marsupialia remain in the matrix only for a time: that of the large kangaroo, which may be regarded as the *type*, or most perfect example, of marsupial animals, being about forty days, at the end of which period the young one is received into the marsupium (abdominal pouch), and there partially exposed to the action of the atmosphere. The labours of birds in forming nests for their broods, and the assiduity with which one, and in some instances both of the parents bring the eggs to maturity, by the heat of their own bodies, are well known. In them too there are differences, from the female that sits constantly, to the one which leaves her eggs for the greater part of the time. Then we come to the oviparous reptiles which are not batrachian; all of which lay detached eggs, or at most they are slightly formed into strings, and they consist, with the exception of the shell, of materials not very different from the eggs of birds, only they contain more gelatine and less albumen, and do not (at least so easily) "boil hard." But all these take some means of protecting the eggs from the direct action of the atmosphere, as if the naked action of that were too much for the power of life which is in them,—or, as if that life required for its development something more than the common working of the elements.

Among the mammalia, wherever the mother is, the young, in the fœtal state, is also there, whether uterine or marsupial. But of animals that are oviparous, or have the undeveloped young separated from the mother, all those which have been enumerated may be considered as *natives* of the land, and produced or evolved by a higher temperature than they could find in the water in its ordinary state: requiring also that temperature to be more uniform than could be obtained in the open air, with even the common alternation of day and night. In all of them there is a natural provision for the bringing about of those circumstances which are necessary for their development; an animal action, opposed to or counteracting the natural operations of inorganic matter, and the only measure that we have of this animal action, is the extent to which it counteracts them. We find that gradually diminishing in the order in which we have taken the animals, till we come to that of the reptiles, which is simply burying their eggs in the earth; and when we look at the animals themselves, we find a corresponding diminution in the development of life, and the energy of all its functions. Some of the saurian reptiles are remarkable for their agility; but it is known that most of them, and it is probable that all, spend no inconsiderable portion of their time in a state not merely of ordinary sleep, but of dormance; that, whether the *winter* to which those powers of activity yield be the natural winter—a season of cold—or whether it be deluging rain or burning drought, they all, to some extent or other, *hybernate*, and during that time, the functions of life in them are very nearly suspended.

But in their hybernations, animals pass to the place of their birth, or to one bearing an analogy to it; and there is not, in all the races which have been mentioned, a single instance of one which hybernates in the water. The alligators and water tortoises make the entrances of their retreats often under the surface of the water; but the chamber of their repose is always above the height of ordinary floods. They received their animation upon the land, and it is upon the land only that they appear to be capable of bearing these long pauses of its action.

But when we come to the batrachian reptiles, we find the beginning of life and the powers of its action in a new element. We find, at the same time, less animal action in the development of the egg, and a simpler and less energetic organisation resulting from it. There are no doubt differences of degree in the different genera which make up the batrachia; but a kind of action, structure, and economy, and even of locality, is common to them all. Generally speaking, they are developed in the water; and if there are any exceptions, it is only the damp earth instead of the absolute pool.

Yet though water is, thus, an element in the developing of the batrachian reptiles, they are not children of the waters in the same sense or to the same extent as the fishes. They come not from the depths; and the eggs which produce them are not aërated by air derived from the water, as is the case with the spawn of fishes, but by air derived from the atmosphere, as in that of the other orders of reptiles.

Among the fishes, we find the spawn deposited at different depths. The bottom fishes lay it deeper than those which play through the waters and find part of their food at the surface. The carp family do not seek the shallows as the salmon do; and eels are produced still deeper than carp. But in all true fishes there is some depth of water over the eggs when the action of life begins in them; for those which are committed to the sea and float there, are, in general, more developed ere they are so committed, than the eggs which are buried in the sand or glued to the stones; and besides, they do not "float out," till they float as the empty tunics out of which the young animals have escaped—as in what are called the "purses" of sharks and rays. If the oviparous animal breathes water through life, the egg is also aërated by means of water when it is in a state of development; and the spawn of no fish can be quickened and matured in dry air any more than the egg of an oviparous land animal can be hatched in the water. The proper distinction is not land and water animals, but animals which breathe the free air, and animals which breathe through the medium of water; and, with the exception of the batrachia, all the vertebrated animals are, from the first action of life in the germ to the last moment of their living existence, true and constant to the one or the other of these. The degree differs, for many air animals seek their food in the water, and some water animals pass part of their time in the air; but still, with the exception of the batrachia only, the vertebrated animals all continue as they begin; and egg or animal, is equally deprived of life, if exposed to the wrong element for a longer time than it can exist without breathing, or being acted upon by that element which is natural to it.

So also, in all these there is no change of form at any stage. There are certain parts of all animals which are not required in the infancy of their lives, and those of course are not then developed; but the animal is substantially the same from the time that it comes out of the egg till its final dissolution.

Thus we have, independently of the ordinary classification of natural history, two grand divisions of vertebrated animals: those which cannot live without air, and those which cannot live without water. Intermediate between these, we have the batrachia, partaking of the characters of both; and although more decidedly reptiles than any thing else in the systems of vertebrated animals, as at present arranged, yet perhaps requiring, in a perfectly natural system, to be formed into a separate order—as should also be the case with the marsupial animals, though even these, in their general economy, do not stand so distinctly alone as the batrachia.

The batrachia may be said to be productions of the surface at which the air and the water meet; though as no animal can live in a mere surface, they find their food in the one or in the other, or in both alternately. In all those, of which the mode of production is known, the spawn or eggs are committed to the water, or to some humid surface, where they have the advantage of the action of water. But they "float out," and have the action of the air at the same time. We are best acquainted with the spawn of the common frog; and that is never deposited in deep water, in running streams which have much current, or in fountains which flow clear and transparent from great depths in the earth, and, consequently, with uniform temperature, or little affected by the state of the weather. Pools and ditches, in which the water is shallow, and which are tangled with weeds in the season, or which otherwise show that they are under the influence of the sun and the atmosphere down to the very bottom, are the places which the frogs select. There the eggs, floating in the water certainly, but still with one side of them exposed to the air, abide all the vicissitudes of the season. They are pelted by the rain at one time, heated by the rays of the sun at another, frozen at a third; and all these often alternately within a very short time. They are thus exposed, too, without any preparation by the parent animals, or any care during the time that they are in progress, being merely cast upon the waters, and abandoned to the elements. They are abandoned to these, too, at the place where their action is the most powerful and the most varied; for a little elevation in the air, or a little depression under the surface of the earth, would exempt them from much of the variable action of the weather.

No other vertebrated animals thus leave their eggs wholly unprotected, or place them on the plane of the greatest action of the weather. But the free air of the atmosphere, the action of light, and the water, are required for the development of the batrachia; and in order to enjoy all these, they must, of course, abide the viscissitudes of the weather. But it appears that they are tempered to the trial which they must thus endure; and though in cold places they are often frozen quite solid, it does not appear that they are thereby injured; for one may see the spawn imbedded in solid ice, and yet when the season comes round, the water of the same pool or ditch swarms with tadpoles. Some of the other species, as, for instance, the common toad, are much more retiring in their habits than the frog, and consequently much more obscure in all their economy. Among them, in the adult state, the principle of life is remarkably tenacious as well as sluggish; and we have instances of their being inclosed in growing trees and yet continuing to live. They also appear to require much more action of the sun to call them from their seasonal repose than the frogs do; and yet they even more habitually avoid the sun's direct action. They do not make their appearance till the earth has been heated by the action of the sun; and not then, till it has been, in some measure, cooled again. Still evenings after summer showers, or dewy evenings after sultry days, and when the sun has a little passed the summer solstice, are the favourite times for these harmless but generally hated animals. They also breed later in the season than the frogs, and do not deposit their eggs or spawn so decidedly in the water; but still humidity appears necessary for its development, as it is often found in showery weather where water has been partially stagnant, in the form of stringy masses of gelatinous or gluey matter, which are, by the rustics in some parts of the country, known by the odd name of "fallen stars." What may have given rise to this absurd name, and to the more absurd belief on which it is founded, it is not easy to say. Toad spawn does certainly appear as late in the season as that at which, in the colder parts of this country at least, the meteors called "shooting stars" are not unfrequent in the evenings; and as these meteors are very generally followed by rain, it is not unnatural that the meteor and the spawn of the toad should be observed in succession; but why the one should have come to be identified with the other, it is not so easy to determine.

The batrachia have not only this double action—the action both of water and of atmospheric air, in bringing them forward in the egg state, but they have a double life afterwards, or, more strictly speaking, they have two successive lives—a first one in the water, and breathing that fluid; and a second one in which, whether on the land or in the water, they breathe air. The last of these lives, or states of existence, must, however, be regarded with some exception or explanation; for there are some genera which retain both sorts of breathing apparatus, and thus are true *amphibia*, and indeed the only known animals which, in a physiological point of view, merit that appellation.

Every one must be familiar with *tadpoles*, or frogs in their first or aquatic state of existence. They are of a dusky-blackish colour; oval in the body, with long fleshy tails compressed laterally, and fringed with a sort of fin. Other than this tail they have no organ of motion, and as the whole of their bodies do not work so well in swimming as those of fishes, it costs them much wriggling of the tail in order to get along. When in this state their mouth can hardly be said to consist of jaws, but rather of two horny mandibles, forming a sort of beak. In this state they are very voracious, as is generally the case with insects in their larva state, or in that state in which they come immediately from the egg; and they eat indiscriminately animal and vegetable matters. How far they are able to go in the way of killing prey has not been clearly ascertained; but they can contrive to nibble with their mandibles till they pick the bones of a little fish perfectly clean.

While they are in this state they breathe water, and are incapable of breathing air. Their gills are placed on the sides of the neck, supported by arches of cartilage, and having their entrance from the mouth, but without any gill-lid to the openings for the escape of the water. Thus, though they breathe water, their breathing is not exactly similar to that of fishes of any kind, though it approximates more to that of the cartilaginous than of the bony fishes. Indeed, it is toward the cartilaginous fishes that the batrachian reptiles approximate in all the aquatic part of their economy. But they are less perfect water-breathers than even these; which would lead to the conclusion that their breathing, and all the functions are but slow even there, as the water has no ingress but by the mouth, and there is no peculiar apparatus by means of which its passage through the gills can be accelerated.

Tadpoles are, in those places which are favourable to their existence, a very abundant production of the season, apparently as numerous in proportion to full-grown frogs as the fry of fishes are to the full-grown of these animals. The pools and ditches in which they are bred also often get dry as the summer advances—although frogs do not deposit their spawn in the water which stagnates from an occasional shower, and which is certain to be dried up before the average season of the tadpoles being able to take to the land, and escape. This last circumstance, whatever may be the instinct which guides the parent frogs in the choice of the water, is what we might expect, because it is part of the general system upon which nature acts. Wherever the egg is deposited, or how completely soever it may be abandoned by the parent, it is always safe in nature's keeping; and upon the average, the egg is always placed in that situation in which it is most certain of being brought to maturity, and the young most certain of being fed until it undergo some change, or can otherwise shift for itself.

But still, though the spawn of the batrachia is deposited in such a way as secures the continuance of the race, the eggs and the tadpoles are, in the case of the frog, so very numerous, that they must answer some other purpose in the economy of nature; for in nature there is no selfishness, no production, which exists for itself only. Also, in the case of those which, like the frog, appear in more states than one, there must be a general use in nature for each state. The egg, the tadpole, and the perfect frog, must all have their part to perform—a purpose which they answer, besides keeping up the succession.

And this natural use of the creatures is twofold: they are useful in that which they consume, and in that by which they are consumed; and if there is a change of state, both uses change along with it. The same insect, as an egg feeds the titmouse in early spring, the warbling songster as a caterpillar in summer, and the bat as a moth in the full heat of the season. It is probable that, but for the tadpoles, the ponds and ditches which they inhabit would, against the torrid season, become rank to pestilence with the remains of small life. But while they are performing this operation, and it is far from an unimportant one, they are preparing the surplus of their own abundant array as subsistence for another race of feeders. The ducks, and all the other birds which nestle in the marshes or on the banks, and dabble for their food in the shallow waters, would, in many instances, fare but scantily, if the spawn of the frogs did not supply them in the early season, and the tadpoles when it is more advanced. Thus the abundance of these creatures in their early stages is not a waste, but a wise provision for other races; and if they were struck out, the blank which would thereby be occasioned in nature would be much greater than one would at first consideration suppose. Indeed, where drainage and culture have taken away the nursing places of the batrachia, the marsh birds also have departed; and there is no question that the one is, to a certain extent, the cause of the other.

And when they are full grown they still have their double use. In the water, or upon land, they restrain the superabundance of insect life under circumstances that do not readily admit of its being done by races differently formed. The leap, which is the prominent motion of the frogs, and which all the four-footed portion of the race can perform, is a motion of capture, as well as of mere progression. The habit varies, and some have more the character of liers in wait; but still they are all fitted for keeping within bounds the exuberance of something, which could not be so well kept down by creatures differently formed.

That over which they are thus set is seasonal, and also occasional, so that they hybernate at those times when the economy of nature does not require their action; and at other times they can endure the want of food long and patiently—to a degree which is utterly incompatible with the nature of animals having more ardent systems. All reptiles have this enduring quality to a very considerable extent; and on that account they may be called Nature's "extraordinary labourers." They remain torpid and quiescent till the season which requires them comes round, and then they are ready, and in action in an instant. One knows not whether most to admire, the perpetual activity of some other races of animals, or the perfect obedience to their time, which is displayed in these. In form and habit they are different, but in purpose and adaptation the one is every way as admirable as the other.

When the appointed season, during which the different species of the batrachia are to remain in their aquatic state as breathers of water, draws to a close, they undergo those changes, both of external and of internal structure, which are to fit them for their new state. But the development of the new parts rather precedes the shedding or absorption of the old ones. Tadpoles may be seen, with the feet pretty well developed, and the swimming tail still adhering; and there is also one period of their lives, however short, in which both sets of breathing apparatus can act. When the lungs assume the superiority, the characters of the land animal predominate throughout the whole structure; but in those genera in which the gills continue, the characters of the aquatic animal continue predominant. *Light* is, however, essential to the change.

The three genera which retain the double function in breathing are, the *siren*, *proteus*, and *menobranchus*. They are all inhabitants of the water; and hitherto they have been found only in America. Their economy in a state of nature is but imperfectly understood; and it is doubtful whether they use both systems either at the same time, or alternately with each other. They are very curious creatures, however; and the little that is known of each of them will be stated under the generic names.

The system of circulation in the batrachia bears some resemblance to that of the other reptiles, and also to that of the fishes. Red blood circulates to the remotest parts, though slowly, and in but small quantity; and the web of a frog's foot, in consequence of the transparency of the integument, and the slowness of the circulation, is one of the very best cases in which to observe the passage of the blood from the arteries to the veins, and thus establish that the grand mass which flows through the system is the same, however it may, in successive portions, be altered by substances with which it parts or takes up.

To observe the living tide at this "turn" of its course, when it has communicated all the nourishment which, at that passage over the body, it is capable of communicating, and when it is about to return, taking up the absorbed surplus and the prepared food on its way, is one of the most interesting points in the animal economy; but it is one which is very difficult to be seen, more especially in animals that have a quick circulation. Artery and vein never anastomose with each other; and, except through the heart, or that which answers the same purpose, they have no communication but through those capillary junctions, which are so small that they are not visible to the naked eye. It does not even appear that they bleed when lacerated; for the blood which is obtained from a wound is either arterial or venous, and never the intermediate blood of the capillary. This increases the interest which is felt in observing the living action; but that action cannot be seen without the aid of a microscope of high power, and that power of course multiplies the velocity as much as the lineal dimensions.

While the batrachia are in the tadpole or gilled state, the system of circulation is exactly that of a fish. The heart has but one auricle and one ventricle. The aorta proceeding from the latter divides into as many branches as there are gills, and thence it returns by veins to an arterial trunk situated on the spine. From this trunk the systematic arteries are ramified over the body, and from their extremities the veins originate, and bring back the returning blood to the auricle. Thus the heart of the tadpole is only a branchial heart, sending the blood to the gills by its contractions, and the systematic circulation is performed by the arteries alone There is thus little or no force or velocity in the systematic circulation, and consequently there is little or no heat produced in the system.

When the gills are absorbed, the arterial branches which carried the blood to them also disappear, only two remaining, which go to the two lungs. These two remaining branches carry to the lungs only a portion of the blood which the heart propels, the remainder going to the systematic circulation without being acted on by the air. The action of the air (or the water, according to the habit) upon the blood appears to be the grand or primary action which regulates all the rest, and the energy of the whole system of the animal is in proportion to the quantity of the blood thus acted on, and the rapidity with which the action takes place. In birds, it takes place not only by the whole current of the blood which passes through the heart passing through the lungs also, but along almost the whole course of the arteries, so that the bird is "lungs all over." In mammalia, the whole passes through the lungs, and in reptiles a part only, and in the case of batrachian reptiles only a small part; hence their coldness, and capability of enduring hunger and other privations.

The change which takes place in the batrachia from breathers of water to breathers of air, by a mere *structural* alteration, and without any change of *substance*, proves that, in principle, these two means of breathing are the same, and that the difference is merely one of mode. The animal which the one moment sends its blood to the gills to be acted on by water, and the next moment to lungs to be acted on by air, is one and the same animal, and the blood so sent is one and the same blood. Therefore, the action which it undergoes must be one and the same action; only the mode is different. As stated in the article Air, it is really *air* which is breathed in both cases, only, in the case of the gills, that air is mixed with water, but there is no decomposition of that water, and no change of it farther than that a certain volume of the air, which it contained in the state of oxygen, is converted into an equal volume of carbonic acid gas. Thus, that which is otherwise only a rational theory, is demonstrated to be truth in the case of the batrachia, and from them the application to all other animals becomes obvious, and even necessary.

There are some other very important points which receive elucidation from the study of the batrachia. Breathing by gills is a much less efficient process than breathing by lungs. There are in the tadpole of the frog tribe eight gills, four on each side, and there is an epual number of arterial branches which carry the blood to them; but there are only two which go to the lungs of the same animal, and they carry only a portion of the blood; consequently, a smaller degree of the action of lungs in breathing air suffices for the purposes of life in the very same animal. But the particular forms of the two kinds of breathing apparatus shows the different modes in which the two fluids act. Lungs consist of cells, into which the air is received, and over the walls of which the small vessels containing the blood are ramified. Gills consist of small fibres or filaments, over the surfaces of which the vessels are ramified, and these filaments are surrounded by the current of water. The air is thus received into the lungs; and the gills are immersed in, or surrounded by, the water. In the former, the action is the resistance of the walls of the cells, which, in animals of warm temperament, is increased by the expansion of the air in consequence of the heat,—and that, by the way, is one of the reasons why the lungs pant and labour when the body is much heated. The action upon gills is the pressure of the water, which, of course, varies with the depth, and explains why animals which inhabit at great depths breathe much more slowly, and are much more tenacious of life, than those which inhabit near the surface. Attention to these points enables us to understand many of the differences of structure, and explain many of the habits of different races of animals, without the labour of individual observation; thus greatly abridging the time and trouble necessary for acquiring that general knowledge of natural history which should be possessed by all who claim the character of being even moderately well educated, and rendering the science a source of pleasure to a much greater number of persons.

Even when the batrachia arrive at that stage in which they breathe air with lungs, their respiration is feeble, as well as limited to a portion only of the blood. They want the proper structure of respiring animals; for though their gills are (with the exceptions already mentioned) replaced by lungs, they have not the apparatus for working those lungs which are possessed by the mammalia, and for which birds have substitutes in their air-cells and air-tubes. They have no ribs nor breast-bone, and therefore the thorax does not act in breathing.

The frogs, as the types of the order, will best serve for illustration upon this, as upon all other points. The frog receives the air which is to be conveyed to the lungs by the nostrils, but there is no vacuum or cavity formed by the expansion of the thorax, as in the mammalia, so that the mere pressure of the atmosphere, following the expansion, does not inflate the lungs as in these. An effort is required after the air is taken into the body, and that is performed chiefly by the tongue. When a frog is breathing with its head to the observer, it may be seen raising and lowering the skin between the bones of the under jaw, but with its mouth firmly shut all the time. The depressions of the skin of the lower jaw last much longer than the elevations, because, during them, there is a double operation to be performed—the expulsion of the air already in the lungs, and the readmission of fresh air into the body. When that skin first descends, there is a contractile action of the abdomen, by which the air in the lungs is driven out; and when that is all expired, the abdomen returns to the neuter or natural state; but being without bones, it cannot form a vacuum, and thus the lungs could not be inflated but by some other action capable of overcoming the resistance of their cells. It is for this purpose that the skin under the jaw is raised, but the motion of raising it is in the tongue. That first shuts the nostrils by pressure near the anterior part of the roof of the mouth, and then rising gradually backwards, it fills all the cavity of the mouth, and forces the air which it contained into the cells of the lungs, which constitutes the respiration. The depression of the tongue opens a passage by the nostrils, and the muscles of the abdomen contracting, force the air out by that passage after it has performed its office. So far is the frog from deriving any aid from the mouth in breathing, that it cannot breathe with the mouth open, as there is then no means of inflating the lungs; and if the mouth is forcibly kept open, the animal as certainly dies of suffocation as the mammalia when both mouth and nostrils are kept closed, though, from the slower circulation, and the fact of only part of the blood passing through the lungs, that catastrophe would not take place so speedily. So also, if the muscles of the abdomen are divided, or paralysed, or otherwise rendered incapable of acting, the air remains in the lungs, and by that means the animal is suffocated.

The skin or covering of the batrachia is in all cases simple, without crust, scales, hair, or any other appendage; and there are some of them that have even no nails on their toes. Those that have teeth have them very small, fitted rather for securing insects and larvæ, which they seize with the mouth, than for biting any animal or other substance. They have no weapon either of offence or defence; for though it is said that pores on the backs of some of the foreign species secrete an acrid poison, yet that is probably no better founded than the old stories of the venom of the common toad, or of the medicinal jewel which it carried in its head.

Taken as an order, they are among the simplest, and certainly the most harmless of animated beings. They doze out the cold season, or other season unsuitable to their habits, in holes of the earth, or at the bottom of the waters. The common frog is especially fond of hybernating in springs, no doubt because of their uniform temperature during the winter. But so far from doing harm there, it tends to render them sweet and pure, by making its first and last meals for the season upon any eggs or larvæ that may happen to be there. In the depth of its hybernation the frog does not eat, and therefore its mouth remains perfectly close all that time, and, from the general rigidity of the all but lifeless animal, it is not easy to be forced open. On this account it has sometimes been said that the lips of the frog adhere and seal up the mouth while it hybernates, an operation for which there could not be any possible use.

There is nothing which man cultivates, cherishes, or in any way sets a value upon, that is in the least injured or interfered with by any of the batrachia. The bull-frogs, indeed, are " horrible musicians," and the love songs of those of our own country are certainly not so tuneful as the songs of birds. Many of the species also offend against our notions of beauty, but in that respect the fault is more in the narrowness of our standard than in the animal. Both our notions and our vocabulary would require to undergo much alteration before we could call a toad " handsome;" but uncouth as the toad is in its general appearance, it has a beautiful and most expressive eye,—an eye by no means deficient in speculation; and it is not unsusceptible of attachment, or insensible to kindness. There have been instances of " pet toads," which, though they lived in retirement in the winter and during the heat of the day, according to the habit of the race, yet knew their master's voice, and came leaping from their hiding place at his call on the fine summer evenings.

The common toad, at variance as its appearance is with our usually-received notion of beauty, is not the most ungainly of the race. Some of the foreign species are much larger, and also more rough and warty in their appearance. One of the most singular looking is perhaps the Surinam toad (*Rana pipa*, Linnæus), which may be regarded as a sort of marsupial reptile. The eggs are placed by the male on the back of the female, much in the same way as if they were the tubers or seeds of vegetables; and after they are fecundated, the female betakes herself to the water. There she remains with the back partially exposed. The skin of her back swells or puckers up, and forms cells in which the eggs are not only hatched, but the tadpoles nourished till their feet begin to grow and their tails to drop off, after which the female returns to the land. This is perhaps the most singular mode of rearing a progeny which is found in the whole range of the animal kingdom. It is somewhat analagous to marsupial nourishment in form, but it is not so in principle; for the young of the marsupial animals are not only quickened, but advanced to a certain stage of their growth before they are deposited in the marsupial receptacle; whereas the eggs of this animal, when placed on the back, are only separate elements of the organic being, and would never advance to maturity, or become animated at all without the other elements.

It now only remains to mention the subdivisions of the order to which to refer for some notices of the more remarkable species.

There are two divisions or sub-orders—batrachia without tails, and batrachia with tails.

Of tailless batrachia, the genera are: TREE FROGS (*Hyla*), COMMON FROGS (*Rana*), and TOADS (*Bufo*); but by some these genera are united, and by others they are further subdivided.

Of tailed batrachia, the genera are: SALAMANDRA (*Salamander*); MENAPOMA; AMPHIUMA; AXOLOTL; MENOBRANCHUS; PROTEUS; and SIREN. These are by no means so common as those of the former division; the history of some of them is very imperfect; and there has been a little confusion produced by confounding them with the saurian reptiles, and calling them lizards.

BATS (*Vespertilionidæ*). A very numerous family of mammalia, belonging to the order or sub-order *Cheiroptera*, or animals with winged hands; that is with the skin between the fingers of the anterior extremities, between these and the posterior ones, and in some instances between the posterior ones including the tail, so much produced and capable of extension as to answer for flight.

Bats have, in all ages, been perplexing objects to systematic naturalists. They have been so on account of what appears to be their double character, the general structure of mammalia, and the motion of birds. With the ancients they were *aves non aves*, " birds yet not birds," and in the progress of natural science to something like a structural classification, they were sometimes arranged with one kind of animals and sometimes with another. Aldrovandi classed them with the ostrich, which, though it now appears absurd, was in accordance with the most striking, and therefore the first chosen ground of classification—the element in which the creatures moved. The bats were quadrupeds which could fly, but they could walk on the ground very imperfectly, or not at all. Ostriches were birds which could run well, but were altogether incapable of flight. Thus each had the structure of the one class and the motion of the other, which made them resemble each other as a sort of mongrels.

If, however, the action itself, or the organisation by which it is performed, be examined with even a moderate degree of attention, it will clearly appear that the motion of the ostrich along the ground is not the walk of the mammalia, neither is the motion of a bat through the air the flight of a bird. The ostrich balances a horizontal spine upon two legs, and a large portion of the middle of that spine is so inflexible, that it may be considered as a sort of beam or balance, poised on the articulations of the supporting legs. But the articulations of the vertebræ of the mammalia all (with the exception of some in the necks only of a few species), admit of motion; and, therefore, there is no part of their spine which can be balanced like a beam, upon two legs articulated at the same distance from the extremities. Consequently, they cannot stand or walk upon two legs but with the spine in an erect posture, so that each vertebra may support the portion above it.

The back bone of a bird, from the insertion of the neck to that of the tail, may therefore be considered as an inflexible beam or lever (at least it is nearly so), supported upon the articulations of the legs as a fulcrum, and, by the well known property of the balance, capable of being held in equilibrio at any angle, except perpendicularly to the horizon,—the flexible neck and tail, and the bendings of the joints of the legs, being the means by which it is kept in equilibrio. In as far as support is concerned, it is evident that if any body is supported on a point, that point may be moved, and the supported body along with it, in any direction and with any velocity, without in the least disturbing the equilibrium of the body. The point upon which the body of a bird is supported, is always in the line joining the articulations of the legs, in the middle where the bird stands equally on both feet, and nearer the supporting foot when it stands unequally; and the motions of the head and tail enable the bird to swing upon this point, without the least tendency to fall. If the bird had any other supports, these would prevent the motions of its body, and actually render it unstable. So that the two feet of the bird perfect its support in standing or walking on the ground; and when the habit of the bird is also to fly (which is the general one), its wings are left entirely free, or available for aërial purposes. When the bird flies, the point of support is transferred to the line of the wings, on which the balance is as complete and independent as that on the feet. The bird has thus *two* systems of motive organs, feet for the ground and wings for the air; and each of these is perfect in itself, and independent of the other. We shall show that the mammalia can have only *one* system; and, therefore, must be either walkers incapable of flight, as in the majority, or flyers incapable of walking, as in the bats. These are no doubt balancing wings, and partially also swimming wings, the structure and action of which will be explained in the article Bird; but it is not necessary to allude to them here, as they form no part of the structural distinction between a bird and a bat.

But if the spine of a bird resemble a *beam* or *lever*, which can be supported and balanced on *one* point, that of the mammalia resembles a *chain*, which unless it can be supported on end, as in the case with man, must have *two* points of support. A chain can merely hang across one support placed not at its extremity; and a certain degree of *tension* is requisite for keeping it in *any* form upon two, as, left to its gravitation, it would fall into the well known curve called the *catenary* (or chain curve). The system of muscles with which the spine of the mammalia is furnished gives this *tension*, and the spinous processes of the vertebræ, which have often so singular an appearance, are the levers upon which these muscles act in putting the spine into the position required. But still no action of muscles on the flexible spine could keep that supported upon a single point, unless nearly on end, as in man.

Therefore, it is not possible to give to the mammalia two sets of motive organs, one for walking and one for flying, as in birds; because both sets of extremities are necessary for supporting the body both on the ground and in the air. In all reasonings on the comparative structures of animals, man must be left out; because none other of the mammalia have only *two* walking feet, and none two hands of all work. Apes cannot walk long in the erect posture, and they walk awkwardly, while all the other mammalia, unless they use all their four feet in walking, merely shuffle along in a sort of sitting posture; and if they were to attempt to walk fairly balanced on their hind legs, the fore part of the body would fall down. So also, though they had wings in place of the fore legs, they could not use these wings for flying. They might assist in a leap, like a parachute; but the moment that the body were committed to them, the hinder part would fall down, in consequence of the flexibility of the spine; the body would turn on the axis of the wings till these were on edge; and then it would tumble to the ground with the head or the heels foremost, according as the one or the other weighed heavier from the axis of the wings. If the spine were inflexible, so that they could balance themselves on wings, they could not use four feet in motion, or turn round without much labour. Some of the saurian reptiles turn with much difficulty, on account of their stiff scaly coverings, though they have articulated spines.

Thus much of the general principles of animal mechanics is absolutely necessary, in order to have any thing like clear notions of the structure and motions of bats; for as all animals are made of matter, and subject to the laws of matter, no animal can act in opposition to those laws without an apparatus capable of overcoming them. A foot cannot walk, or a wing fly, unless it accord with the general organisation of the body; and two structures which are incompatible with each other cannot act at all. The winged horses, and the winged beings otherwise in human shape, which we meet with in paintings and sculptures are, on this account, incongruous combinations; and if the beings which they are meant to represent could not fly without the wings, they could not possibly fly by means of them, as the action of wings is perfectly incompatible with that of fore legs or arms.

It was similar ignorance of, or want of attention to, mechanical possibility and consistency, which led to the confounding of bats with birds; but as the principles of zoology began to be better understood, and animals were classed more according to their physiology, it was admitted that the bats were true mammalia; and in consequence of the pectoral mammæ of the females, and some other external appearances, Linnæus placed them in the same order with man and the ape tribe.

The faultiness of that classification is easily seen; but it would seem much more easily seen than corrected. Cuvier ranks them and the other cheiroptera as the first family of his great order *Carnassiers*, of which the *Carnivora* form another family. This is an instance of very defective nomenclature; for "*carnassiers*" is the literal French translation of the Latin "*carnivora*;" and thus the definition of the order and that of the family should be the same, and one of them useless, or else the same word is used in different senses. Cuvier had certainly too great a fondness for classing animals according to their teeth or other feeding instruments. His notion evidently was to include all animals which have digital extremities and the three kinds of teeth, with the exception of man and the quadrumana, in one general order. But if that order include the bats, it might also include the quadrumana; for the characters of these are not more different from those of the true carnivora. The quadrumana are separated on account of their organs of motion—organs adapted for climbing trees; and surely climbing the air, or floating along in that element, is as distinctly marked a character. If we take into account the whole character and economy of the animals, we shall find that the bats have fully as many in common with the quadrumana as with the beasts of prey. So that, though Linnæus proceeded more by general analogy and Cuvier more by anatomical dissection, Linnæus is in this instance not more incorrect than Cuvier. *Cheiroptera* should unquestionably be a separate order, if the system is to guide us to the affinities or relations of animals; and if not, we might as well be without any system. When we take the proper distinctive character of the cheiroptera—the flying membrane, and look for the affinity—the possession of the same character in an inferior degree, we do not find it in the *carnivora*, but in the *rodentia* and the *marsupiata*—in the squirrels, and the *phalangista* and *petaurista*; and with these there is the same relation in habit as in structural character. See Classification.

With the exception of a single genus, and that probably not consisting of more than one species—the genus *Galeopithecus*, the "cat-ape," or the "flying cat" of common language, all the *Cheiroptera* are called bats. That genus has pectoral mammæ, and the skin of the sides enlarged so as to form a parachute, extending nearly to the points of the toes; but it has none of the true bat characters. It does not fly, that is, it does not, by the action of the fore legs, give itself fresh impulses while in the air. It is a climbing and leaping animal, and its extremities are far better adapted for these purposes than for flight; whereas the bats can neither climb nor leap, at least they must, from their structure, be very awkward at either. The peculiarities in the structure of the bats receive no illustration from that genus, nor from any other animal, nor can they be used in explanation of any other; therefore, whether they are to be called an order or a family, the bats should stand alone; and doing so, they form a very well-defined natural group, a group no member of which can be mistaken if the characters of any one are well understood.

The *characters* of the bats as a group are: the skin of the sides produced into a broad and thin membrane, which extends to the points of the toes; the toes, or fingers, of the fore-legs very much produced, and united by a thin and broad membrane; the thumb separated from the fingers, generally very short, and furnished with a strong crooked claw, which the fingers are generally without; the membrane wholly or nearly naked, and having a leathery appearance. The hind legs are much shorter than the fore, the toes on them but little produced, and each of the toes furnished with a crooked claw. The length of the tail varies, being in some of the species merely rudimental; it is generally included in the membrane, but does not appear to be the efficient instrument of steering or keeping the course in the flight of the animals. That appears to be done chiefly by the motions of the hind legs, while the fore legs are the grand instruments of flight. The hind legs have not any peculiar muscular structure, by means of which they can be very efficient in moving the wings, and, when the animal is extended, the motion which they have is horizontal rather than vertical. The fore legs, on the other hand, have little horizontal motion, and cannot be moved much either in advance or to the rear; but their vertical motion is powerful; and, in order to give insertion to the large pectoral muscles which produce it, the sternum or breast-bone is provided with a prominent *crista* or ridge. The shoulder-joint, or articulation of the *humerus*, admits of a considerable range both of elevation and depression; but the joints of the elbows, wrists, and fingers, do not admit of being stretched beyond the straight line. The wings, or rather the "membranes of flight," for they are not wings either in the form of their bones or the nature of their covering, thus admit of partial flexure or folding when they are raised; and when they first "take the air," in their downward stroke, they are hollow, by which means they take a better hold, and this hollowness in some degree compensates for the want of feathers, the fibrous structure of which takes hold of the air without the assistance of hollowness, at least to the same extent, though all birds which fly with a fluttering or bat-like motion have the wings more or less hollow. The membrane of flight is very thin and light, and admits of being folded into very little space when the animal is in a state of repose. Such are the general characters as dependent upon the organs of motion.

The organs of nourishment have a general resemblance to those of the other mammalia which feed upon insects and other small invertebrate animals; but with a general modification to suit the habit of the tribe, and particular ones in the different genera. The gape of the mouth extends very far backwards, and also opens wider than in most animals of the same size. In these respects it has some resemblance to the gape of the bills of birds which catch insects when in flight, especially to the goat-suckers, which, like the bats, are nocturnal or twilight feeders. It is further worthy of remark, that these birds which, in their mode of preying, certainly resemble the bats more than any other animals, can make little or no use of their eyes in the catching of their prey. The front or incisive teeth vary in the different species, the canine are generally large, and the grinders have short protuberances. The intestinal canal is simple and without any cæcum, indicating food of easy digestion. This last character forms a very marked distinction between the bats and the galeopithecei, which have the cæcum large, and are more of vegetable feeders.

The organs of sense are variously developed. The ears are in general large, and in some of the species they have a duplicature or second concha, as if there were one ear within another. It is hence presumed that the sense of hearing is acute; and it *may* be that those which have the duplicature to the ears have the means of closing up the auditory passage, so that they may not be disturbed in their repose during the day. The nostrils and also the mouth are also sometimes surrounded by produced membranes, the use of which is not very well known. Perhaps they aid the sense of smelling, which is generally acute in nocturnal feeders; perhaps they assist in the capture of the insect prey; and perhaps they are in some measure organs of touch. The eyes are very small and deeply enfonced, something like the eyes of moles; and though they must have the power of vision, it does not appear that they are essential to the animal in finding its way, even when that is intricate. The well-known experiments of Spallanzani, which were verified by others, proved that when blindfolded, or even blinded, bats can find their way through between obstacles of which they could have had no previous knowledge; and indeed though we, reasoning from ourselves as the example, are very apt to suppose that what we call the caution of animals is a matter of experience, yet, prejudice and false analogy apart, experience appears to have little or nothing to do in the matter. Spallanzani suspended willow rods in the room in which he turned the blind bats loose to fly; but, though he shifted these so as to make the passage between them as varied and as intricate as possible, the bats never struck against one of them, though they kept flying about in all directions.

A question has hence been raised as to the means by which bats do contrive to avoid obstacles; and the same question may be extended to very many other animals. A horse in the dark pauses when he comes to a closed gate, though he never was the road before; nocturnal beasts do not more frequently fall into pits and over precipices, than beasts which are abroad during the day and have their eyes to guide them: and nocturnal birds do not fly against trees any more than day-light birds. People, too, will keep a *well-known* path though the night be pitch dark

In the last case we are in the habit of saying, that "the feet know the road;" and the saying is probably not very wide of the truth. "Feet" or "head," we know *that which we have learned*. Animals need no learning in the performance of their natural functions; and therefore they know all ways instinctively which their habits lead them to, and the nocturnal ones have no more difficulty in the dark than the diurnal ones have in the brightest sunshine: another proof of the wisdom and goodness of the Creator.

This, it will naturally be said, is not an answer to the question; but, though it would be easy enough to *write* more, it is in truth all that can philosophically be given. That the animals feel a different resistance in the air in time to avoid the obstacle, the pit, or the precipice, is evident; but *how* they feel it, or even what name we are to give it as a *sense*, is another matter. Of sensation we have no knowledge beyond the experience of our own senses; and what is said respecting them, even by those who are accounted the "authorities" in matters of physiology, is vague enough. The most rational theory on the subject is, that as the sentient animal is *one*, all the senses are essentially one also, only modified by different organs. And if modified by different organs in the same body, much more may they be modified by bodies which are specifically different, so that the sense which has apparently a similar organ, and to which (on that account) we give the same name, may be very different in two different animals. We are accustomed to say that a blood-hound, which follows upon the "slot," has a very exquisite sense of smell; but the hound cares nothing for roses or mignonette, or all the perfumes in the world; and the eye of the eagle, much as has been descanted on its power of vision, has no perception of beauty either in forms or in colours. The flying membranes of bats, thin as they are, contain a beautifully reticulated plexus or net-work of nerves, and the texture of them externally is of that description with which we usually associate a very delicate sense of touch. But still we cannot say that such a surface is absolutely necessary; for it appears that the whiskers of cats, the delicate fringes in which the wing feathers of owls terminate, and many other surfaces and substances in which there do not immediately appear to be any nerves, give indications equally delicate and certain. A blow on the horn of an ox appears to pain the animal even more than a similar blow on the hide; and treading on the toe is not a tittle the less painful for its being fortified by the mail of a corn.

Delicacy of sensation is rather a quality of the general constitution of animals than of any local organ; and the bats appear to possess it in a very high degree, not only as regards the contact of solid substances or the mechanical motions of the atmosphere, but as regards light and temperature. They cannot bear wind, they come not abroad during the day, and they hybernate in the winter. The temperature which suits their nature appears to be more limited than that of almost any other race of animals.

Their *habits* all tend to show this. They breed at the very hottest time of the year; and the young, which are usually two in number, are naked and helpless at their birth, capable only of clinging to the teats of their mother, which, however, they do with the greatest firmness and pertinacity. This habit in them is necessary, for the mother does not lie down or even stand on the ground when she suckles her young, as is the case with most of the mammalia. She hangs suspended, by the nails of her thumbs, or more generally by those of her hind feet, to the branch of a tree, or some cranny or irregularity in a ruin. There is no nest in which she can leave the young ones when she goes out to feed; and thus she must bear them about attached to her body till they are capable of flight. The female has no marsupium; but this habit resembles a little those of the marsupial animals—the young are very immature when produced; and their nest and place of safety and repose is the body of their mother.

Some of the species occasionally fly during the day, but that habit is by no means common, and is confined to some of the foreign species which are in part vegetable feeders. In temperate climates, they conceal themselves during the day, even in the season of their greatest activity. Caverns, holes of trees and walls, and ruined buildings are their retreats; and from these they issue forth as dusk begins to set in, flutter about in their laborious flight, and capture such insects as are then on the wing—gnats, mosquitoes, moths, and beetles; and their wide gape with its formidable teeth is an excellent trap for the capture of such prey. The service which they render to vegetation, by the destruction of insects which in the larva state prey upon it, is very considerable, even in temperate climates; and some of the hot countries in which they swarm by myriads, could not, but for them, be inhabited. In humid places on the margins of tropical forests, mosquitoes are troublesome enough as it is; but if the bats did not thin their numbers, they would be utterly unbearable. Those species too, which frequent the towns and settlements are useful in other respects. Most of the race are miscellaneous in their feeding, and not very delicate in their taste. They devour indiscriminately all animal substances, whether raw or dressed, and whether in a recent or a putrid state.

But though they are thus voracious in their feeding, they can endure hunger for a great length of time; and the waste of their system appears to be but small. When the weather is favourable for their feeding, they very soon get fat, and when they are compelled to remain longer in their retreats than usual, the fat is absorbed, and they get lean again.

In temperate climates, they disappear by the time that the cold evenings of autumn set in. Their retreats are the closest crannies which they can find, and there they are often clustered together in heaps. In high latitudes they remain in their dormant or hybernating state for a long time; but the short period during which they do feed is more favourable for them than in lower latitudes, as it is twilight all night long. While they are hybernating, the digestive functions are wholly suspended, and the circulation so nearly so that it cannot be perceived in the smaller vessels. The respiration, of course, is feeble in the same proportion as the circulation. There is thus very little waste in the system, and very little absorption of fat can supply it; but how long they could exist in the dormant state before they perished of exhaustion has not been ascertained. The lowest temperature at which, in our latitudes they come out, varies according to the species, from about 42° to 48° of the common thermometer.

The extreme sensibility to light and to touch, which has been already mentioned as not confined to any particular organ, is finely shown in the dormant state. Be that ever so deep, the creature shrinks from the touch, even before actual contact, and so does it from a candle or any other light; but these have no tendency to awaken it from its profound slumber, which shows that the sensibility is not in consequence of activity in the other functions of the animal.

When, however, the requisite degree of heat is applied they revive, and show themselves as obedient to it as ever. But in order to revive safely they must revive gradually; for if they are *forced* by a high temperature, such as exposure to the fire, they awaken only to perish; and the operation appears to give them pain, something similar to that which is felt when the frozen hands are held to the fire. The injury is probably the same—the rupture of the small vessels.

When they are awakened in that gradual manner which does not destroy them, their circulation, their breathing, and their appetite return; and if they have slept long, and their fat is nearly all absorbed, they must soon eat, or perish of hunger. Casual awakenings during the season of repose are, therefore, highly injurious to them; and it is to avoid these that they betake themselves to places which are so concealed as that the vicissitudes of the weather do not readily affect them; but they, of course, do not go into those which never during summer acquire the temperature at which they revive. But the more constant the winter, and the cooler the place of their retreat, they are safer; as the contrary circumstances are apt to rouze them before the season can supply them with food.

Though the bats are, upon the whole, useful rather than hurtful to man, they are creatures to which poetry and superstition have in all ages had recourse to deepen the feelings of loathing and horror. The bats are things of the doubtful light—the dim twilight, which, in ages of ignorance, converts white stones into ghosts, and bushes into spectres. They dwell in the ruined wall, or the rifted earth; and they also often found their way into the sepulchres and catacombs of the ancients. They were thus dwellers with desolation and with death; and it was but stretching the imagination a little further to suppose that they were in league with these loathed and dreaded powers. And the rapacity of the bats in their feeding during the twilight gloom, and the miscellaneous nature of the food, gave still farther colour to the supposition. Hovering about the temples, they ate greedily the blood and other remains of the sacrifices; when famine or pestilence, which were then of frequent occurrence, though fortunately known to us chiefly by name, strewed the earth with the bodies of the dead, and when night closed upon the horrors of the battle-field, the bats came to the nocturnal feast; and as in all cases they came fluttering and apparently formless, with wing most unlike any organ bearing the same name which is spread to the light of day or the sun of heaven, they perfected their claim of poetical alliance with the infernal regions, and the powers which held dominion there. As the peacock was the bird sacred to Juno, the queen of heaven, so the bat was the creature sacred (or accursed, if the word is better liked) to Proserpine, the empress of hell.

The use of them for these purposes is as old as Homer, who very skilfully manages them in heightening the graphic effect of the splendid passage in which he describes the shrieks and wailings of the ghosts in the regions of woe; and, after Homer, all poets and painters who have ventured upon similar delineations, have made use of the bats for the purposes of effect. Even to this day painters must borrow the wings of bats to their devils, in like manner as they borrow the wings of pigeons to their angels; and one has only to throw a deep Rembrandt shade over a piece of canvas, and show a bat's wing partly displayed from a cave, in order to give an infernal air to it, and make it, with very little painting, a good poetic representation of the gates of hell. It is easy to see how a race which is linked with such associations should have had but a scanty measure of justice meted out to it by the half superstitious naturalists of the middle ages; and a remnant of the same superstition is, no doubt, the cause of much of the horror which is associated with some of the larger bats of the warm countries.

In Britain, though there are several species, the individuals are no where numerous, unless where the whole colony of a country-side are found clustered together hybernating, or hiding themselves from the day in solitary and seldom-frequented caves. This occurs most frequently in the southern parts of our island; and there are some of the rarer British species which have been found only in such situations. No where, however, and of no species, are British bats so numerous as to form a striking feature in the natural history of the country. A few of the common bats may be seen flickering about villages and farm yards on the fine stilly summer evenings; and they stand accused of making small inroads upon the dairy and the larder; but still there is not sufficient interest about them for creating much attention, and they have rather to be sought out as curiosities than otherwise. The thinness of their numbers as compared with those in the nearly corresponding latitudes of continental Europe, may be accounted for by the nature of the climate, and the effect which, as already explained, it has upon creatures so sensitive. Taken altogether, the temperature of our year is too uniform for being favourable to this family of animals, and taken in the details, it is too variable and inconstant. Our summers have too much rain in them for making good bats' weather; and our winters are too mild—they keep them awake after their food has become scarce; and they not only awaken them again too early in the season for its reappearance, but they very frequently awaken them to certain destruction in the winter and the spring.

Common Bat.

But there are many countries where bats are far more numerous than any other species of mammalia, and where they are consequently very characteristic. These are the richer parts of the tropical countries, and some of the islands in the warmer seas. Such places are often crowded with bats, which fly in swarms, darkening the twilight almost to the gloom of night; and during the day coat over the larger caves and places where they hide themselves, as if they were stalactites. These places are also rendered offensive by them, for their forms are lurid and ugly, the odour which they give out is rank and offensive, and their cries when disturbed are harsh and disagreeable.

Of course they are not, from their habits, found in desert or in naked places; because there they would neither have shelter during the day, nor food during the twilight. Places where life, and especially vegetable and insect life, are rich almost to rankness, are most favourable for them. The banks of the Nile in Egypt, where they dwell in the palaces and sepulchres of forgotten kings, and the temples of forgotten gods, are particularly replenished with them, because the swelling and subsiding of the Nile cause a vast production of insect life. In India also, especially toward the western coast, where the monsoons first break, and rain and fertility are most abundant, they appear in great plenty, and swarm in the stupendous cave temples, which were formerly hewn out of the rock with so much labour, but which are now nearly abandoned to clustering bats suspended from the roofs, and crawling reptiles on the floors. In the fertile parts of New Holland they are also very numerous; and they are particularly so in the South Sea islands, which appear to be their head-quarters, at least in that part of the world. The prevailing species there is of large size; and yet Forster mentions that, at the Friendly Islands, he counted more than five hundred suspended from a single tree, hanging in all sorts of ways, some by the heels, and others by the thumb claws.

In some of these islands they stand accused of being a plague, barely less destructive than that of locusts. They do not confine their depredations to the twilight, or to animal substances, but come abroad at all hours, their numbers darkening the air and their ravages extending to fruits, flowers, the juice of trees, and in short to every thing consumable. In some places, however, the inhabitants make nearly the same reprisals on this species, as the Arabs do on the locusts; they eat them and consider them a delicacy. Even the French in the isle of Bourbon, follow the fashion of the Moors and Malays in this species of food; they make soup of the bats, which is said very nearly to resemble hare soup, both in colour and in flavour.

In America, especially in the northern, or richer part of South America, bats are also very numerous, and the larger species there equal in size, and far outdo, in uncouth appearance, the largest and worst looking of their congeners of the East. It is there where the vampire stands accused of sucking the blood not only of single individuals of the human race, and single animals of other species while asleep, but of cutting off in this way whole herds of cattle, when these were first introduced into South America by the missionaries. Many of these accounts are no doubt exaggerated, and not a few of them are, in all probability, utterly groundless; but still they have been so often repeated, that they cannot be altogether without foundation. The superstitions which we have mentioned as being continued from the time of Homer, must no doubt have done much to heighten the pictures of the American bats; but their effect could not have continued without at least some admixture of truth.

The details of the bat family are much too extensive for a single article in a popular work. There are not fewer than 140 or 150 species or varieties, forming many genera or subgenera. Several of these, however, are made up from museum specimens, of the manners, or the native localities of which, little or nothing is known. These, of course, do not come within the scope of popular natural history, as they are merely curiosities to look at, which have got "no story to tell." Of those which have a history, the more remarkable species can be more advantageously mentioned under the names of the genera—to a very brief analytical list of which we shall devote the remainder of this article.

The family admit of convenient division into two sections; first, those which have the grinders adapted for bruising vegetable food; and secondly, those which have not,—the last being the true bats.

I. *With teeth for bruising vegetable matter.* This group comprehends by far the smallest number. There are two genera, which differ in their characters, and the species are also subject to considerable variations, and often to local variations of size and colour in the same species. They are all natives of the south-eastern parts of the old world, especially the Oriental Archipelago, and the isles in the Indian and Pacific Oceans. The incisors or cutting teeth, are more or less chisel-shaped or trenchant, and the grinders have their crowns not exactly tuberculated like insect feeders, nor entirely flat like those that live upon vegetables, but formed into two ridges in the line of the jaw with a furrow between; but the ridges wear with age and the furrow becomes partially obliterated. The number of teeth is also either not constant in the same species, or they are liable to fall out with age. The following are the genera :—

1. Pteropus ("winged foot," called *Rousettes*, by the French naturalists, and having no general English name). Of these there are two subdivisions, one without tails, and the other with rudimental ones; the former being the most decidedly vegetable feeders in the structure of their teeth.

The members of this genus are the largest of the whole family, the body of the largest one being a foot in length, and the extent of the wings or flying membranes not less than five feet. The first or index finger of their anterior extremities consists of three phalanges of bones, and has a small nail, which is not the case in any others of the family. It is, however, much shorter than the middle finger, which is greatly produced, and gives the wings a pointed appearance. The third and fourth fingers consist of only two phalanges of bones, and are without nails. The flying membrane originates in the sides, and is much divided between the hind legs. The muzzle is simple, or without any appendages; the nostrils are apart from each other; the ears are of moderate size and consist of only one membrane; the tongue is covered with recurved hard papillæ; and the stomach is elongated, and varies in diameter in the different parts. They are in great part vegetable feeders, very numerous, gregarious, and destructive to the fruits and other crops; but they are also understood to prey upon birds and the smaller mammalia. One of the division with tails, and which has the tail rather longer than the others, and partially detached from the flying membrane, inhabits as far to the westward as Egypt, where it resides during the day in the caves or excavations near the Nile.

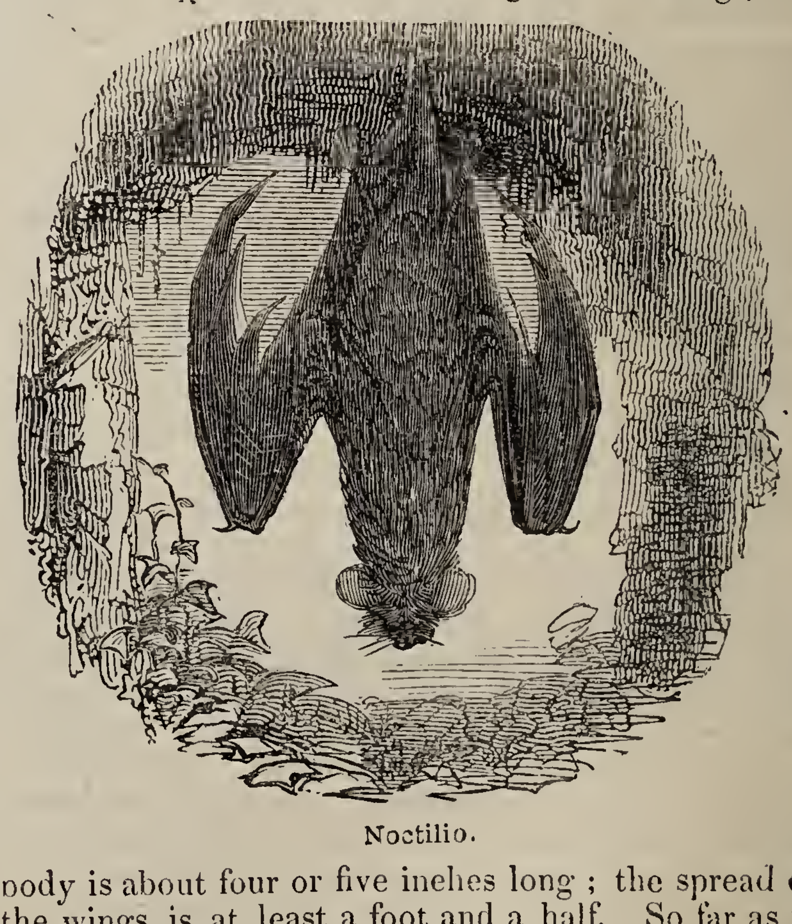
2. Cephalotus. The teeth in this genus resemble those in the former, but the flying membranes are different. Instead of originating at the sides, as they do in the former species, they meet at the dorsal line or ridge of the back, and are attached to the body at that line only. The fore fingers have three phalanges, but the last one is small, and has no nail. Some of the species are subject to the loss of their front teeth, which is, indeed, so common an occurrence in many species of the family, that a different number of those teeth cannot safely be taken as a positive specific difference.

II. *With insectivorous teeth*, that is, the crowns of the cheek teeth have prominent tubercles. These are the true bats. All the species of this division have three phalanges of bone in the middle finger, and only two in all the rest. They are far more numerous, varied, and generally distributed than the members of the previous section, though from the peculiar nature of their food, they are not generally found in such numbers in any one locality. There are many well authenticated genera of them, besides a number of rather doubtful ones, being founded entirely upon museum specimens, of the history of which in the living state nothing is known.

1. *Molossus*. This genus has the muzzle simple but the head large, the ears also large, united to each other at the base, and furnished with a small secondary membrane. From the form of the head some of them are called "bull-dog bats." They are wholly or chiefly confined to the American continent. They are subject to variations in the number of the front teeth.

2. *Nyctinomus*. These have two large conical front teeth in the upper jaw, and (generally) four small ones in the under. Their grinders, of which there are four on each side above and five below, are furnished with very sharp tubercles. The lips are deeply wrinkled, or with a furrow in front. The nose is flat, but without any membranous appendage. The ears are large, united at their bases, and have an external duplicature. The wings are very large, the hind feet covered with long hair. The body not exceeding three inches in length, and generally smaller. They are found in Egypt, India, the Oriental islands, and Madagascar; and also, as is said, in Brazil, and some of the West India islands, but their existence in the latter places wants farther confirmation.

3. *Noctilio*. This genus have four front teeth above, the two middle ones longer than the others; two front teeth in the under jaw, the canines large and strong, the cheek teeth four on each side of both jaws, with very sharp tubercles on their crowns. The muzzle is short, thick, covered with fleshy tubercles, and cleft with a furrow, in a manner similar to that of the hare, on which account they are popularly called hare-lipped bats, though some of them are also called bull-dog bats. The nose is without any membranous appendage, the ears are small, placed towards the sides of the head, and not united at their bases. The membrane between the hind legs is large, but does not reach entirely to the point of the tail. The claws on the hind feet are large and strong; the



Noctilio.

body is about four or five inches long; the spread of the wings is at least a foot and a half. So far as is known, they are all natives of South America.

5. *Phyllostoma* (leaf-mouth). This genus is so named from the leaf-like appendages which are attached to the mouth, or rather to the nose, one of which has very much the form of a leaf, the other more that of a horse-shoe. They have four front teeth in each jaw, and five cheek teeth in each side of both. The tail is wholly or partially detached from the interfemoral membrane. The ears are large, naked, and not united at their bases, but they have a second membrane in the form of a triangular flap notched at the sides. Their tongue is protrusile, and furnished with papillæ which adapt it for a sucking instrument; and the lips are also beset with fleshy tubercles. The body, even in the largest species, is not above six inches long, and the wings are short in proportion, which renders the flight fluttering and apparently laborious. It is to this genus that the vampire bat, of whose leech craft so much has been said and written, belongs. All the species are natives of the warmer parts of the American continent. They are usually divided into three sections: those which have no tail, those which have the tail united to the interfemoral membrane, and those which have the tail free.

6. *Megaderma* (large skin). So called from the great production of membrane about the nose and ears. Their noses have the leaf still more complicated than in the last genus. The inner appendage of the ear is also large and often forked. The external ears are united on the top of the head. Their tongue is smooth, and not adapted for sucking, as in the *Phyllostoma*. They are without tail; and the interfemoral membrane is entire. They have four front teeth in the lower jaw, but none in the upper; and the intermaxillary bone is cartilaginous. They are all natives of the hotter and more productive parts of the eastern world, especially of tropical Africa and the oriental islands.

7. *Rhinolophus* (crested nose). These are commonly styled horse-shoe bats. They have the nasal membranes very complicated, and extending toward the forehead in a shape which rudely resembles a horse-shoe. The tail is long and united to the interfemoral membrane. They vary considerably in size, but the largest does not exceed four inches in length. They are all of them natives of the eastern world; most abundant in the Oriental Archipelago, but in some of the species extending to Europe, including England.

8. *Nycteris*. These have a longitudinal furrow along the forehead, partly covered by duplicatures of the integuments, but no membrane attached to the nose. Their ears are very large, but not joined to each other; and their tails are included in the interfemoral membrane. They have a pouch on each side of the mouth, opening into a sac formed by a duplicature of the skin. They are of small size, with the wings long in proportion; and inhabitants of the eastern world, chiefly of Africa.

9. *Rhinopoma*. The nose long, blunt, or apparently truncated at the end, surrounded by a short membrane, and the nostrils capable of being shut, at the pleasure of the animal, by means of a membranous operculum or lid. The ears large, united at their bases, and the ends hanging over the face, containing an inner membrane. The interfemoral membrane narrow, and straight at the posterior edge, not extending to the extremity of the tail, which is long and slender. This bat is a native of Africa. There is said to be an American species, but it is, however, doubtful.

10. *Taphozous*. These have a rounded channel on the forehead; but are without any membranous appendages to the nose. Their head is of a pyramidal form; they have four front teeth in the under jaw, which are three-lobed; and in the upper they have only two, and sometimes none. Their ears are not joined to each other, and the tail is above the interfemoral membrane, and not attached to it. The males have a cavity placed crosswise, on the throat. The membrane is produced so as to form a small pouch on the wrist. They are found in various places in the warmer latitudes of the eastern world, especially in Africa, and it is said that there are some species in North America.

11. *Mormoops* (owl-eyed bats). These have a triangular membrane on each side of the face, extending from the nose to the ear, which forms a sort of shade to the eye. The form of the head is much more pyramidal than in the former genus; and there are four front teeth in each jaw, those in the upper one very large. They are found in the Oriental Archipelago.

12. *Vespertilio*. This genus comprehends the common bats, the species of which are very numerous, and generally distributed over the globe. They have no prolongation of membrane, save that which they use in flight. They have four front teeth above, the two in the middle pointed, and apart from each other; and they have six below, which are partly trenchant, partly tuberculated or lobed at their points. Their tail is included in the flying membrane. There are several species natives of England.

Pigmy Vespertilio.

13. *Plecotus* (long-eared bats). These are without any appendages to the nose, but the ears are very much produced, the external ones being as long as the head. The internal duplicatures are lancet-shaped, and there is an operculum or lid to the auditory passage. They are said to be found both in the eastern and in the western world, and one species is by no means of rare occurrence in England. See figure p. 320.

The best known British bats are,—two species of the horse-shoe bat, the larger and the less; three of the common bats, the common, the margined and the great, and two of the eared bat, the common and the barbastel. The habits of bats are, however, so obscure, that it is not easy to say that all the species in any country have been discovered; but as the habits of the animals is not migrant, all that are observed in any country may be considered as natives.

Long-eared Bat.

From this list of the genera, short as it is, and incomplete as not containing the numerous ones which have no history, it will readily be seen that the natural history of the bat family is no short or easy matter. Their vast number and variety, their being most abundant in those places where all natural action is the most energetic, and their being fitted for living on so many different kinds of food, show that the part which they perform in the economy of wild nature, must be an important one. It is true that they are preyers, as all animals are, whatever may be the kind of their food. But, in the economy of nature, preying is not destruction but preservation; and, in the animal kingdom, strange as it may seem at first sight, predation tends quite as much to preserve the races which are preyed upon, as those which are the preyers. Life is, in all its forms, too energetic for the means of life; because the one is an energy—a principle, not in its nature trammelled in by material bounds; the other is regulated by the quantity of matter which can exist in a particular form. It is this excess of productive power which keeps the system going; for if there were no more of each kind produced than were necessary for the continuation of that kind, all means of nourishment would be at an end, and the whole would speedily perish. But the caterpillar eats the superabundant leaf; the little songster eats the caterpillar; the omnivorous bird destroys in part the eggs of the songster; the omnivorous bird falls a prey to the rapacious bird. So in the mammalia, one eats the grass, a second the grass eater, and the series goes on, both in the animal and the vegetable kingdom, till fungi feed upon the ruins of the oak, and the larvæ of insects fatten upon the carcass of the lion. And if, by any contingency, the race to which it is given to regulate the numbers of another race or of other races should fail, nature still has its resource, so that those which have gotten the mastery, shall not keep it, to the destruction of others and ultimately of themselves; *epizooty* comes, as "the pestilence which walketh in darkness," and cuts off, one sees not how, those numbers which have increased beyond that wholesome balance which is the best for all. This is the beauty of the system of nature,—that which elevates it far above what we could conceive or imagine, if we did not derive our knowledge from the direct contemplation of the system itself. As there is implanted in every individual a means of repair and renovation, which works without foreign assistance during the average period which it is required that the individual should last; as there is implanted in every species a means of continuation, to which all the other propensities of that species must yield; so there is implanted in the whole a means of general preservation, by which one race is made to support and preserve another, and which, while it is plastic or obedient to those physical changes, to which the whole must ultimately be subservient, yet so acts upon the whole, that, under all the vicissitudes of place and of time, there is at all times, and in all places, the maximum of beauty and natural usefulness. Not only so, but the whole is given to man as a volume of instruction, which he cannot read with understanding without the full profit to himself from the reading. Go to what place of the globe he may, if he will but study the working of nature there, in the proper manner and without bias brought from other places which are different, he cannot fail in finding the means of turning all the capabilities of that place to his advantage, in the easiest manner, and with the greatest certainty of success.

All the productions of nature, animate and inanimate, are indices to this knowledge, if we give ourselves the trouble of finding out the mode of applying them. If we find any one species of production, whether animal or vegetable, predominant, we may be sure that that production is the most intimately connected with the active powers of the place—with those powers of which we must avail ourselves if we are to turn it to our practical advantage. If we do not attend to these means of instruction, we not only increase the quantity of our labour, but we, in many instances, labour in vain, and not merely in vain, but we actually defeat, by our ignorant exertions, the very objects which we have in view.

There are but few instances in which our science guides us to the right application of what nature has to teach; and in the case of animals so peculiar in their structure, and so obscure in their habits as the family of the bats, we may say that we are, hitherto, almost without the lesson of utility. They are, however, one of the races which should especially stimulate us in our inquiries. They are extraordinary animals, for they have the structure of one class and the habit of another; and whenever we find these extraordinary combinations in nature, we may be sure that they are for the accomplishment of purposes as extraordinary.

What the specific purpose in the case of bats may be, we have said that the present state of knowledge does not furnish us with data for ascertaining; but they afford us one instance of a very curious fact,—namely, that none of the elements in which animals can exist is confined to a single class; and as the mammalia are those which appear to have all the functions of life in the highest state of development, we find them seeking their subsistence in all the three elements,—on the earth, in the waters, and in the air, in the case of the bats.

BAUERA (Hortus Kewensis). A genus of two species of greenhouse shrubs, named in honour of Francis and Ferdinand Bauer, eminent botanical draughtsmen. Linnæan class and order, *Polyandria Digynia;* natural order, *Cunoniaceæ.* Generic character: calyx from six to eight cleft, persistent; corolla from six to eight or more petals; stamens below the germen;

filaments filiform; anthers oval, two-celled; styles two, diverging.

BAY TREE. The *Laurus nobilis* (Willdenow). This celebrated tree is a native of Italy, and among the Romans was the emblem of victory. It is scarcely hardy enough to bear severe winters, unless the situation be high and dry. It is beautifully evergreen, and grows like a great bush rather than a tree, and emits a very pleasant resinous scent like that of myrtles. The leaves are used by cooks and confectioners for flavouring dishes, &c.

BEAR (*Ursus*). A genus of *Plantigrade* mammalia, or those which apply the whole sole of the foot to the ground in walking; and by much the largest and most formidable of those which have this habit. The genus cannot be considered as strictly and exclusively carnivorous, but rather as one which is very miscellaneous in its feeding; and yet when goaded on by hunger, or roused by any thing irritating, there are few animals which show greater ferocity, or rend in pieces that which they overcome with more savage display. Animals whose general habit is predatory always kill their prey in what may be called a "business-like manner." They attack some vital part, so that their attack speedily becomes fatal; and those which are of inferior mechanical strength, very generally bleed their prey to death by a small incised wound; nor is there one among the habitual preyers on living animals which begins to eat till the prey has ceased to live. But when the bear "plays the butcher," he does it like one whom nature has not bred to the trade. He tears away at the part upon which he first seizes, and when he tears from hunger, the moment that he begins to tear he begins to eat. His feast upon a warm-blooded animal is thus the most sanguinary and savage to be met with in nature. But it is so far from being habitual to him, that he probably never has recourse to it if he can find food of any other kind. Wild berries and other fruits, in search of the last of which he can climb with great dexterity, honey, which he also generally finds in the trees, the eggs and young of birds, small mammalia, and, when it comes in his way, carrion, however putrid, are the ordinary food of the bear.

This must not, however, be considered as extending literally to the white, or polar bear; for that species, by inhabiting the margins of the polar ice, has to depend chiefly on the sea for food, and in that case he must feed upon animal matters—indiscriminately on what the sea casts up, and on those who come to feed upon it, but chiefly upon the former.

Bears of some species or other are found in every latitude, and therefore their habits must vary with the climates and seasons of these; but there is a very considerable uniformity of structure in the whole race; and the typical ones, or those which possess the character in the highest degree of perfection, are certainly the inhabitants of cold climates. The natives of the sunny lands—though there they are in the cave and the forest, rather than the sunshine—are feeble in body and subdued in temper, compared with the dwellers on the margin of the polar snow. Not a cold climate merely, but one in which nature has a long winter of repose, seems to be best suited for developing the character of the bear, or rather, it is the extremes of seasons which suit them, and not any particular degree of average temperature, for they live under the equator as well as in the polar circle.

Bears may be considered as animals of the northern hemisphere, in both continents of which they are found; but they do not appear to extend to the south of the equator, except, perhaps, on the Andes, where there is the temperature of every climate over a vast range of latitude; and there are none in New Holland, or even in Africa. It is not improbable that those which are found in the forests of the tropical countries may have originally migrated from the north, and been gradually changed by climate; and it is certain that, in Europe, they were much more abundant in former times than they are now. The diminution has taken place not merely on account of the breadth of surface from which they have been driven by thicker peopling and cultivation, and the destruction of them by hunting—for in western Europe they have become few in those wild forests which culture has never invaded; and where men begin to till the ground, and follow the other occupations of civilised life, they hunt much less than when, in far fewer numbers, they are wholly dependent on the wild productions of nature.

The improvement of climate, or, at all events, the approximate equalising of the seasons, of which the diminished number of bears is one of the evidences, does not appear to be wholly the result of culture. Much of Europe to the southward of the Baltic, and about the Black Sea, and also not a little of Asia to the northward and eastward of the Caspian Sea, has certainly, at some period of the world's history, been under water. Of this fact, science furnishes us with abundant evidence confirmatory of Holy Writ. At that period, also, there must have been much of it under forest; and from these circumstances we may conclude, that then the climate much more resembled that of the northern parts of America than it does now. The few facts which we are able to glean from history prove this, although all which we can regard as authentic refer to times much more recent than when this must have been the case. But the inhabitants of ancient Rome were certainly as familiar with snow as the inhabitants of modern London; and the Tiber was as often frozen over then as the Thames, even above the tideway, is now.

At these times it is highly probable that the bears of Europe ranged seasonally from the Baltic or from Scandinavia to the Mediterranean, just as those of America still range from the northern parts of the Stony Mountains to the shores of the Gulf of Mexico.

With us, therefore, the history of bears is a history of those whose day has gone by; and though we have no record of the more ancient races in history, we have indubitable monuments in the bones of the animals themselves, which are found in no inconsiderable numbers in plains much farther to the south than any which the bear now inhabits in Europe. The bones of the great extinct species (*Ursus spelæus*), the size of which must have been equal in lineal dimensions to that of the horse, and, from the different form of the animals, vastly more in solid contents and in strength, are found, though sparingly, in some of the caves in England; and although, unlike as the animals are to each other, there is some popular confusion in the names of the *bear* and the *boar*, yet there is little doubt that, even later than the time of the Romans, the common brown bear was to met with in both the southern and the northern division of Britain.

At present the line of its habitation is much farther to the northward in western Europe, though in the eastern part of the old continent it is more southerly. The numbers, also, increase towards the east; and are probably greater about Kamtschatka than any where else; though there, as well as throughout the rest of Siberia, they are very systematically hunted, but it is only by a very scattered population.

In considering the progressive history of the bears, we are, therefore, to regard them as on the decline in the eastern continent, in the north of Europe, and in Siberia, and when we turn to those parts of North America which have been settled by Europeans and their descendants, we find that, though the commencement of the decay be more recent, the progress of it has been much more rapid, though it does not appear that, in that part of the world, any species has become extinct. These few observations will, at least in part, show to what stage of the history of countries bears belong; and we shall now give a short descriptive notice of them as an existing race.

The generic characters of the bears are, briefly, these:—The incisive teeth are six in each jaw, those in the upper jaw have one large middle lobe on their points, and a smaller one on each side, and those in the lower jaw have two lobes. The canines are conical, slightly bent, and placed at some distance from the incisives. There are three false molars in each side of the upper jaw, and four in each side of the under. These are all of small size, and liable to decay or fall out. Then there is one carnivorous or tearing grinder, and three tuberculated ones in each side of both jaws. The carnivorous teeth are proportionally smaller than in the true carnivora, and they are not of quite so tearing a character,—the anterior point is wanting, and the central and posterior ones are rather small and blunt. The tongue is soft. Such is the structure of the feeding organs in the bears; they are by no means well adapted for feeding upon flesh in its recent state; and they accord with the fact, that the animals never attack when they can find food which is more easily managed.

The muzzle is variously produced in the different species, and terminates in a moveable cartilage. The sense of smelling is understood to be keen; and from the soft tongue, and the partiality of the animals for honey and other sweet substances, it is presumed that the taste must also be acute. The eyes are small, and, in the ordinary states of the animal, by no means ferocious in their expression. The ears are also small. The body is very thick and strong; and the length of the covering, which is intermediate between wool and hair, very thick and firmly planted in the skin, gives them a shaggy and clumsy appearance. This is in part increased by the mode of walking, and by the tail being so very short as to be with difficulty perceived. There are no clavicles to keep the shoulder bones steadily apart, and thus, as the fore legs are moved, the blade-bones "work" much more on the sides than in animals which have clavicles. The hind legs too, seem awkward, especially to us who are most familiar with four footed animals which walk on the toes, and have the first flexure of the leg with its joint projecting backwards. That joint, which is really the ankle-joint, is at the ground in the bears, and thus the first joint of their hind legs, bends the other way from that with which we are most familiar.

From these peculiarities of formation, we are accustomed to regard a bear as an animal which is "loosely put together," and that it must walk with pain and difficulty. Such, however, is not the case. The broad base which the foot of the bear forms, enables it to walk very securely, even in difficult paths; its progress is more rapid than we could suppose; and the firmness with which it can stand on the flat soles of the hind feet, enables it to use the fore-paws in grasping. The want of clavicles enables it to grasp and hug between the fore-legs, much more powerfully than could be done by a clavicled animal; and this power is of great service to it, not only in climbing, an operation to which it must often have recourse for its food, but in hugging its enemies, which it does so powerfully, that a strong animal is strangled by compression of the chest. Climbing is, however, the proper function of the want of clavicles, and climbing by grasping the bole of the tree between the paws, and not by grasping with the single paw, as the quadrumana do with their hands. And this mode of climbing answers uncommonly well in those places where the bears are most abundant. Pine forests are its haunts; and where pines grow close together, they have no lateral branches till a considerable height above the ground. Such trees could not easily be climbed by animals which grasped only with the hands. The paws of the bear have the claws long and strong, and moderately bent, adapted for digging, but capable also of inflicting very dangerous wounds; and while the animal hugs with the fore-paws, it is very apt to lacerate with the claws of the hind ones.

Bears live chiefly in dens and holes of the earth, though rather in natural ones than in those of their own forming; and they not unfrequently take up their abodes in hollow trees. This method of lodging is one reason for which they prefer places which are rough and wild, for they spend much of their time in their habitations. They hybernate less or more, according to the climate, and during the time of their hybernation they, like other animals which have that habit, cease to eat. They do not require the same shelter as most hybernating animals, in consequence of the almost impenetrable thickness of their winter coat, and of the quantity of fat which, at the time when they retire, they have accumulated under it. These protections prevent their temperature from sinking so low as that of most other hybernating mammalia; and the consequence is, that their functions are not so completely suspended—their slumber is not so profound. They do not move about, neither do they eat, but live upon the accumulated fat; and when the climate renders the time of their retreat long, they reappear again in a very lean and exhausted condition.

There is some difference in the hybernation of the sexes, at least in some of the species, and it is perhaps what we would not, upon a superficial view of the matter, expect. The pairing time is the summer season, a little sooner or later, according to the climate, so that the period of hybernation is that of gestation. One would at first suppose that there should be then a demand for nourishment in the female much greater than in the other sex; because, although her own system may be, in many of its parts, in a state of indolence, we must suppose that it must be active in so far as the bringing forward of her progeny is concerned. But the female retires much earlier in the season than the male, and her hybernation appears to be much more close and profound; nor does she again come abroad till her young ones are able to accompany her. We need hardly mention, that the old story of the cubs of the bear being perfectly shapeless until they are "licked into shape" by the tongue of the mother, is wholly without foundation. As is the case with the young of the genus *sus*, which, though it belongs to a different order, has many habits in common with the bear, the young are rather more handsome than the adult animals. The cubs are rarely, if ever, more than two, and often only one at a litter; they grow rather slowly, and follow the dam for a year, or at least for the whole season of her public appearance. She is a most attached and affectionate mother, bold beyond imagination almost, in the defence of her offspring, and they, even when very young, are ready to "show fight" in defence of her. This maternal affection must have been early noticed; for, in the Bible, a "bear bereaved of her whelps" is selected as the type of implacable and unrelenting vengeance. This is not confined to the land bears, but extends also to the polar or maritime bear, which, from its size, and the manner of its feeding, is a much more formidable animal than the common land-bear, and far more so than the bears of southern climates.

Such are some of the general characters; and we shall now proceed to notice the leading species. The most natural order, or at least, the most convenient one in which to take them, may perhaps be this: first, the land-bear of Europe and of the north of Asia; secondly, the polar or sea-bear, as connecting Europe and America, and being perhaps most abundant on the northern shores of the latter; thirdly, the bears of North America; fourthly, the bears of the more southerly regions of that part of the world; and fifthly, the bears of Southern Asia and the Asiatic isles.

European Bear.

1. *Land Bear of Europe and of Northern Asia.*—It is probable that there is only one species, though that species is subject to many climatal variations both in shape and in colour; and the readiness with which it undergoes these may be an argument for the original identity with it of the bears of the south. Of this, however, there is and can be no proof, so that we can include in the species only those which inhabit what may be considered as a continuous locality.

This species (*Ursus arctos*) is usually styled the "*brown* bear," and brown in various shades is, no doubt, the prevailing colour; but it is so far from being invariably brown, that there are specimens met with in all the shades of colour from black, or at least dark bistre, or soot colour, through brown, up almost to white, though the white retains that half straw-colour sort of tint which is found in the bristles of pigs. The colour is, generally speaking, darker in the summer, and paler in the winter, at which time the skin is finest, and most esteemed; but there is only a sort of bleaching by the weather, and not a change of colour, as in those animals which pass the winter in very cold countries without hybernating. The brown bear is said not to take up the whole of his fat by internal absorption, but to extract a considerable portion of it by licking from glands in the pads on the soles of his paws. This is the popular opinion; but it is certainly a singular mode of feeding, and it is at least as likely that he performs the operation alluded to in order to keep up the heat of those parts of his body. There are, no doubt, instances of animals eating their own hair or feathers, and even gnawing the flesh off their bones, but these have happened only in the very extreme of hunger.

Though the brown bear shows a great deal of spirit when hunted or otherwise attacked, and the female is always dangerous when she has cubs; and though when pressed with hunger either sex is ferocious enough, the habit of the animal is not to attack. The bears which are led about the streets for show are ferocious, but then they are made so by cruel treatment. They are blinded, muzzled, and then beaten, to make them play tricks; and they of course must resent such treatment, and resent it indiscriminately, as they are incapable of seeing the aggressor. When the barbarity of the age was such as to include bear-baiting among "sports," the bears kept for that purpose were naturally savage; but this again arose from the treatment they met with. Indeed, as in the case of many other animals, bears have been made the scape-goats of human cruelty, and have been doomed to bear to the wild forests, and hold there, as their native birthright, savage propensities which are of human origin.

Bears when taken young are not difficult to tame; and in that state they are playful and harmless, though, according to the general habit of animals which are domesticated solitarily, they probably get more ferocious as they grow older. On board vessels which trade to Russia tame bears are sometimes kept, which play about the deck and climb the rigging, but these are generally young ones; and though they do not attack, if duly fed, they are apt to "show fight" if annoyed.

In all countries which it inhabits, the brown bear is a favourite animal with the hunter; and it is among the most valuable of the wild ones. The flesh is, at all ages, wholesome; and in the young ones it is good. To the rude tribes which inhabit the north of Asia, the brown bear is an animal of no small value. "It would be difficult," says Tooke, in his *View of the Russian Empire*, "to name a species of animals, excepting the sheep, so variously serviceable to man as the bear is after his death to the Kamtschadales. Of the skin of this animal they make beds, coverlets, caps, gloves, and collars for their sledge-dogs. Those who go upon the ice for the capture of marine animals make their shoe-soles of them, which have this advantage, that the wearer is in no danger of slipping with them. The fat of the bear is held in great estimation as a very savoury and wholesome nourishment; and when melted, and thus rendered fluid, it supplies the place of oil. The flesh is reckoned such a dainty, that they seldom eat it alone, but usually invite a number of friends to partake of the repast. The intestines, when properly cleansed and scraped, are worn by the fair sex as masks to preserve their faces from the effects of the sunbeams, which here, on being reflected from the snow, are generally found to blacken the skin, by which means the ladies of Kamtschatka preserve a fine complexion. The Russians of Kamtschatka make window-panes of the intestines of the bear, which are as transparent and clear as those made of Muscovy glass. Of the shoulderblades they make sickles for cutting grass. A light black bear-skin is one of the most comfortable and costly articles of the winter wardrobe of a man of fashion at Petersburgh or Moscow; and even the small white hand of a belle is slipt into a huge bear-muff, which half covers her elegant shape."

In as far as the muffs are concerned, the females of this country are as fond of handsome bear-skin ones, and, no doubt, wear them as gracefully as they of the land of the autocrat. In the temperate latitudes, neither bears' flesh nor bears' grease is much used, or at all known as a culinary article; but the latter is in no small request as a cosmetic; and were it not for bears' grease, half the perfumers in some of our cities might close their bazaars. Thus, in some portions of its body, the bear becomes an article of export to the people of those countries of which it is a native; and where the grease is the matter in request, it is understood to be necessary to fetch the bear entire, and fatten it with offal in the cellar of the vendor. Hence there is a very considerable demand for live bears, as well as for the skins of dead ones; and though it is highly probable that one veritable bear may impart virtue and give currency to the lard of a hundred hogs, yet an occasional bear becomes necessary, in order to prevent the said lard from lapsing into its original state of simple emollient ointment, good for the skin when rigid, but perfectly inert and passive in the matter of ringlets in either sex.

Many stratagems are naturally had recourse to for the capture of an animal which is in so much request both at home and abroad. The direct methods are to attack him openly with clubs, spears, or fire-arms, according as the captor may be provided. In those parts of Siberia where wood is plenty, a trap of logs is formed by the side of his path, and a trigger placed, which he cannot avoid pulling to his own destruction. At other times he is snared in pitfalls, in the bottom of which sharp-pointed stakes are placed, and the mouth of the pit is covered with sods placed upon as slight a platform as will bear their weight. The bear is a cautious animal, and anxious to escape from anything which is novel in appearance. Thus the hunters place in his path an elastic "bugbear," which shall start when he touches a cord attached to it, and frighten him off in the direction of the pit. In case the bugbear should not succeed, other means of annoyance are placed in his path—such as "caltrops," or pointed double crosses of iron, which, toss them about as you will, always present a salient point—logs hung vibrating from the branches of trees—and other things of artificial contrivance with which the bear, in wild nature, is unacquainted. If these do not drive him to the pit-fall, they perplex him, make him stand still, and throw him off his guard, so that the hunter, who is generally lurking about, can approach sufficiently near for taking a deadly aim. At other times, again, they bend an elastic tree, secure it by a cord, and place on it an attractive bait, which the bear has no means of reaching but by ascending the bending tree. This he readily does; but before he can reach the alluring prize his neck is entangled in a noose, placed there on purpose, and so contrived, that a very little action against it shall detach the cord by which the tree is held in the bent position. When that is done, the tree springs up with so much elastic force that it jerks the bear clear of every thing but the noose, and at the same time so tightens that upon him, that he hangs suspended, to be cut down when it suits the convenience of the hunter. In the rugged and mountainous parts of Siberia they contrive in a still more singular, and rather an ingenious manner, to make the bear his own executioner. They fasten a noose to a very heavy block of wood, and place it in the bear's path, near the brink of a precipice. When he finds his neck entangled, and that the rope keeps him fast to the block, he attacks the latter, and with great fury tumbles it over the precipice, as the best means of getting rid of it; but the treacherous cord still unites him to it, and he tumbles headlong after it. Bears are, from the structure of their bodies and the thickness of their covering, little liable to be hurt by falls, unless the height be very considerable; and thus the bear often arrives at the bottom along with the log, without having received any injury. If in such cases there is still a descending precipice, he again moves the log toward that, tumbles it down, and follows it as before; and if there is not, he is at great labour in carrying it up again, and will repeat the operation till he is completely exhausted by the fatigue, unless he shall be stunned by the falls. Indeed, he is so valuable, that no small portion of the ingenuity of the natives is exercised in various modes of snaring and otherwise capturing the bear.

As wild honey, wild fruits, and the other substances upon which the brown bear feeds, are very abundant in the Siberian forests, the animals themselves are there both numerous and well-fed. And there they have little or nothing ferocious in their character, but eat their food peaceably, and when the season of its failure comes, they retire to pass the season of want in their hybernal dens. So far are they from being accounted ferocious or disposed to attack man, that the women and children range about with perfect freedom, and without the least apprehension, in those parts of the forests where the bears are numerous. As they are not much disturbed, except toward the close of the season, when they begin to get fat, they are not timid any more than forward, and it is possible to pass them as closely and as safely as if they were sheep. The sudden appearance of a person in an unwonted dress alarms them and makes them take flight; but it is said that the most certain and efficient of all bugbears is an umbrella, the expanding of which makes them roar and run with all their might; an umbrella is indeed an object of more dread to most wild animals than the most efficient weapon that man can brandish. A fierce bullock is more certainly turned by flashing an umbrella open in his face than by any other means;

and there are recorded instances of the tiger being put to flight in the same way.

This species of bear is found in so many places, and these so wide of each other, that we might expect numerous varieties both in size and in colour. The form of the head is the most permanent characteristic, and serves better than any thing else to prevent the breaking down of the species into several, or the confounding of it with the bears of America, which it often very much resembles both in colour and in size. Even in Europe the "remnants," as we may call them, as they are partial residences of an animal which was once general, differ considerably from each other; but still, the bear of the Pyrenees, the Alps, and the mountains of Lapland, is specifically the same; and it is probable that, with similar interruptions, from tracts of country which are either thickly inhabited or have become deserts, it ranges in Asia, from the Polar Sea to the Himalaya Mountains. The bear of Nepâl is different in appearance from the bear of Kamtschatka; and it is also different from the bears of India and the Oriental Islands; but its characters are so nearly intermediate between the bears of the extreme north and the extreme south, and its locality also so nearly intermediate between them in latitude, that it may be that the whole are, as has been already hinted, climatal varieties. All are climbers, all are vegetable feeders, and all are mild and peaceable in their manners, when they have plenty of food and are not harassed and annoyed.

The proneness of this animal to variety in colour renders it unsafe to infer a difference of species from any thing except difference of form in the skeleton, or differences of habit which cannot be accounted for from differences of climate and food. Hence the distinctions of brown bears, black bears, cinnamon bears, and white bears (as land animals), which have sometimes been described as inhabiting the same or nearly the same parts of the eastern world, instead of being distinct species, are not even distinct varieties, as the colour changes from generation to generation as well as in different individuals.

The abundance of bears in the Swiss Mountains in former times is proved by their having given name to *Berne*, and at that place bear-pits are still kept up in honour of the name. In these pits they are fed entirely on vegetable matter, the chief part of which is bread; but, according to a regulation of the police, all unripe fruit of whatever kind, which appears at the Berne market, is confiscated for the use of the bears. If a similar regulation were made in some other cities, we should probably hear much less about cholera in the later summer and earlier autumnal months. The high condition of the Berne bears, the length of time which the same individuals have lived, and similar circumstances in other places, all tend to confirm the inference from the structure of the teeth, that this bear is essentially and properly a vegetable feeder.

2. The Polar Bear, or Sea Bear (*Ursus maritimus*). The dreary climes to which this species is confined, the perils and privations to which it must often be exposed amid turmoiling waves and reeling mountains of ice, the peculiarity of its form and appearance, its great strength and power of enduring much hunger and the very extreme of cold, the many tales which are told of its ferocity and daring, the strong attachments and kindly feelings which it displays to its kind and in its domestic circle, all conspire to render it not only the most interesting of the bears, but one of the most interesting animals in nature.

The polar bear is well named from its locality, as it is never found without the polar circle, except in longitudes where the extremity of the polar winter extends further to the south; and that takes place in America only. It is a land animal, or more properly an ice and snow animal, rather than an aquatic one; and yet its sole dependence for the greater part of the year, and its principal dependence during the remainder, is upon the sea.

Its office seems to be that of chief scavenger to those regions in which the extremes of season produce the extreme of animal mortality, and though its system of dentition resembles that of the other bears it is, from its locality, as much of an animal feeder as they are of vegetable. Being an animal feeder, it has a more habitual propensity to kill than the land bears. But still, the prey which it pursues and captures in the living state is not land animals, but animals of the sea—not fishes, though occasionally it may not reject them, but the aquatic mammalia; and more especially those smaller kinds which subsist by being fishers. Of these, the seal is perhaps its staple food; and as the seals do not hybernate, but keep breathing holes open in the ice, even in the depth of the polar winter, this species of food is accessible to the bear at all times of the year. In winter too the foxes and wolves of the northern regions seek the ice, because their summer food on the arctic lands has either migrated to milder climates or is buried beyond their reach in the snow; these animals may form part of the winter repast of the bear during the portion of that season when it keeps the ice. Indeed the fact of its hybernating or not is not very well ascertained, though the probability is that the male, at least, is not so long dormant as in the land bears of the north. Neither does it appear that hybernation is general in the species; for captain Lyon mentions having seen one (a male of course) prowling about during the very coldest part of the season. But that the females retire, at least for a time, and that some of the males may do the same, would at least agree with the general habit of the genus. Mobility appears to be the grand preventive of hybernation. Of this we have instances in human beings who have all but perished in the snow; and those who are out in the inclement season, and fatigued under a rigorous atmosphere with the ground clad with snow, know how dangerous it is to lie down in the hope of being recruited by a little rest. The sleep which comes on in these cases is not the common restorative sleep which is so necessary for recruiting the vigour of the body. It is a sleep of the circulating and breathing system, as well as of the powers of sense and observation. It falls in short upon the whole animal, and there is no energy left awake by which a recruiting can in any way be effected. Hence, when it takes place in man, or in the ordinary animals in mild climates, and is continued for even a moderate portion of time at a very low temperature, the system wears out, and life becomes extinct. If the body is covered by a considerable depth of snow, the catastrophe is by no means so speedy; and the lengths of time which both human beings and domestic animals have continued to live under such circumstances have often been referred to as marvels. Those who perish in this manner seem previously to pass into a true hybernating state; and their subsequent death is rather death from starvation than from cold; for when found they are wasted to skeletons, which leads one to suppose that if supplied with a quantity of fat similar to that which hybernating animals accumulate in the autumn, and equally capable of taking up that fat by absorption, those who are wreathed up in the snow might in all probability survive for months.

Thus we see that the necessary adjuncts of hybernation are, protection from the extreme cold of the atmospheric air, and a supply of fat which can be taken up by absorption. The polar bear is in both of these respects, more especially in the former which is the more immediately required means of preservation, exceedingly well provided. His fur is thick, close, of great length, of a bad conducting colour, and it appears to have a property the influence of which in preventing cold in animals has been greatly or wholly overlooked, but which is probably the most efficient of all. The fur of this bear, like the feathers upon diving birds, cannot be wetted in the living state by almost any exposure to water. Of course, hair having this quality cannot be cooled by evaporation of its surface. Now we know from the great danger of catching cold, if the human hair is suffered to continue wet after washing, that evaporation at the surface of the hair cools the body, if not to an equal extent as evaporation from the skin, yet much more than evaporation from the portion of skin upon which long hair grows. Indeed, hair suceptible of being wetted would not be a protection against cold, unless the cold air were perfectly dry; and thus it is natural to suppose that all animals capable of hybernating in the snow have their hair or other covering not susceptible of being wetted. That this is the case with the polar bear is well known, because after swimming, which is a common habit with him, he has little more to do than shake himself in order to be quite dry.

The distinguishing characters of the polar bear are—the great length of the body compared with its height; the length of the neck, the smallness of the external ears, the large size of the soles of the feet, the fineness and length of the hair, the straightness of the line of the forehead and nose, the narrowness of the head, and the breadth or expansion of the muzzle. In the plate, "Bears," (No. I.) Landseer has very faithfully represented this animal with his characteristic accompaniments—the spicular ice, the aurora borealis, the fragment of the walrus, and the crest of the wave as in the very act of congealing. The attitude is that of the bear when he "scents," which he often does at very long distances, and when ranging, if he cannot find his way on the ice, he will swim for many miles, still preserving the scent. His rate of swimming is about three miles in the hour.

The size varies considerably. Some are mentioned as long as thirteen feet; but the accounts of these are in all probability exaggerated. Captain Lyon mentions one eight feet seven and a half inches long, and weighing 1600 pounds, as this is one of the largest specimens on the account of which we can confidently depend, it may not be amiss to quote the particulars as given by captain Lyon from actual measurement.

"*Length.*—From the snout to the insertion of the tail, eight feet seven inches and a half; the head only one foot six inches; from the eye to the ear ten inches; from the nose to the centre of the eye eight inches; of the ear alone four inches and a half; the tail from root to tip five inches; fore claws five inches; hinder claws one inch and a half; canine teeth two inches and a half.

"*Girth.*—Round the body, seven feet eleven inches; neck, three feet four inches and a half; fore-leg, two feet three inches; hind-leg, three feet three inches; round the snout, one foot nine inches and a half; round the forehead, two feet one inch.

"*Breadth.*—Paws, ten inches; between the ears, one foot three inches; canine teeth, three inches."

Bears of so large dimensions as those just quoted are not frequently seen, the usual length being between six and seven feet, and the weight, unless when in very high condition, considerably under 1000 pounds, those killed in the latter part of the season being always heavier in proportion to their lineal dimensions than those killed early. The weight of one only six feet eight inches long, killed by Captain Ross on his first arctic expedition, is described as being upwards of 1100 pounds. When in the highest condition, the girth of the body near the fore-paws, is very nearly equal to the length; but, at other times, they are, of course, more slender. The length of the soles of the paws is about one-sixth of that of the whole animal; and from the measures above quoted, it will be seen that they are very broad. The vessels of the legs are secured from the influence of the cold air, by the very long and thick hair with which their inner surfaces are covered.

These bears are very powerful animals, and there is no species in the whole range of nature better adapted to the situation and circumstances in which it is placed. It seems indeed to be a general law in nature that, in proportion as any species of animal is limited in its distribution, its adaptation to the place to which it is limited is the more perfect. We have instances of this in the apes, the sloths, and various other animals which are confined to particular districts in tropical climates; and we have a remarkable instance of it in the polar bear. The paths of this bear, when he ranges in quest of his food, are in the average of cases over the ice; and he has frequently to stand upon that while, by main force he hauls the food out of the water; and that food is often living animals, which of course make all the resistance in their power. But the vast size of the bear's paws enables him to stand on a broader base than even the elephant, while the great length of his neck gives him the power of reaching to a considerable distance. His claws are neither so long nor so crooked as those of the land bears; and from their form they are digging claws more than climbing, or prehensile ones. These agree with his habits. He is not a climber; and he cannot well be, for there is nothing to climb in the places of his habitation, save rocks and ice-bergs, and animals do not climb these by means of their claws. His want of clavicles enables him to grasp the jutting points of the ice or rock between his fore-legs; and the long hair upon their inner surfaces, prevents them from being lacerated, or benumbed by the cold. The form of the claws enables him to dig his food from under the snow when such an operation is necessary; and the texture and colour of his coat render him proof to all the vicissitudes of seasons and of weather. The Arctic summer with its continual sunshine, and the Arctic winter with its temperature so low as that mercury may be hammered on the anvil, are equally the same to the polar bear. On the ice, or in the water, be the weather fair or foul, nature has furnished him with abundant protection in the natural coat on his back. Thus, he can move about and find his food under circumstances to endure which few other animals are equal; and if food should fail in the severity of the winter, he could, and in all probability does, lie down to hybernate on the bare snow or ice.

The ice upon the polar seas is not so smooth as that which forms upon fresh water in lower latitudes, because, when it is first formed, the water is generally in motion, and there is not unfrequently snow, so that there is a scum of trash, or icy fragments, before the water consolidates into a continued field of ice. This gives it a granulated surface, which is afterwards powdered over with snow, which falls not in flakes, but in small particles, when the cold is very great. This surface, when once it is formed, remains undecayed during the sunless months; but when that luminary begins to exert its influence, the surface alternately thaws and freezes, at which time it becomes so slippery that it is difficult footing. To the polar bear, however, it is a safe path, and that animal never slides or stumbles be the smoothness of the surface what it may.

From its great size and strength, the polar bear is, under all circumstances, a powerful animal; but upon the ice it is peculiarly at home, and the danger of attacking him there is much greater than anywhere else. The following anecdote, recorded in his "Narrative of a Voyage to Greenland," by Scoresby, whose writings have thrown so much valuable light upon the economy of the polar seas, will afford some idea of the conduct of the bear on the ice.

In the summer of 1820, "the ship, a Hull whaler, was moored to a piece of ice, on which, at a considerable distance, a large bear was observed prowling about for prey. One of the ship's company, emboldened by an artificial courage, derived from the free use of rum, which, in his economy, he had stored for special occasions, undertook to pursue and attack the bear that was within view. Armed only with a whale-lance, he, resolutely, and against all persuasion, set out on his adventurous exploit. A fatiguing journey of about half a league, over a yielding surface of snow and rugged hummocks, brought him within a few yards of the enemy, which, to his surprise, undauntedly faced him, and seemed to invite him to the combat. His courage being by this time greatly subdued, partly by evaporation of the stimulus, and partly by the undismayed, and even threatening aspect of the bear, he levelled his lance in an attitude suited either for offensive or defensive action, and stopped. The bear also stood still. In vain the adventurer tried to rally courage to make the attack; his enemy was too formidable, and his attitude too imposing. In vain, also, he shouted, advanced his lance, and made feints of attack; the enemy, either not understanding, or despising such unmanliness, obstinately stood his ground. Already the limbs of the sailor began to quiver; but the fear of ridicule from his messmates had its influence, and he yet scarcely dared to retreat. Bruin, however, possessing less reflection, or being regardless of consequences, began with audacious boldness to advance. His nigh approach, and unshaken step, subdued the last spark of bravery, and that dread of ridicule, which had hitherto upheld our adventurer: he turned and fled. But now was the time of danger. The flight of the sailor encouraged the bear, in turn, to pursue, and, being better practised in snow travelling, he rapidly gained upon the fugitive. The whale-lance, his only weapon of defence, encumbering him in his retreat, he threw it down, and kept on. This fortunately excited the bear's attention. He stopped, pawed it, bit it, and then renewed the chace. Again he was at the heels of the panting seaman, who, conscious of the favourable effects of the lance, dropped one of his mittens. The stratagem succeeded; and while bruin stopped to examine it, the fugitive, improving the interval, again made considerable progress a-head. Still the bear resumed the pursuit with a most provoking perseverance, except when arrested by another mitten; and finally, by a hat, which he tore to shreds between his fore-teeth and paws, and would, no doubt, soon have made the incautious adventurer his victim, who was now rapidly losing strength, but for the prompt and well-timed assistance of his ship-mates, who, observing that the affair had assumed a dangerous aspect, sallied out to his rescue. The little phalanx opened him a passage, and then stood to receive his bold assailant. Though now beyond the reach of his adversary, the dismayed fugitive continued onwards, impelled by his fears, until he fairly reached the shelter of his ship. The bear once more came to a stand, and for a moment seemed to survey his enemies with all the consideration of an experienced general, when, finding them too numerous for a hope of success, he very wisely wheeled about, and succeeded in making a safe and honourable retreat."

Whether the bear would, in this case, have fled from the sailor, if the latter had at once gone boldly in with his weapon, instead of pausing in fear and brandishing it, is not known; and there are no doubt instances in which the bear does attack man, though the grand object of attraction for him is carrion and offal. It is the flesh of the seal, the odour of which becomes very rank, which allures him to the huts of the northern people, just as it is the larder, and not the people, which attracts the black bear of America to the habitations of the back settlers; and the instances in which he attacks the people or their domestic animals are few, and confined to those times at which his proper food fails.

That food is, as has been hinted, the carrion of the sea, or, in the absence of that, the sea mammalia—the seal generally, and the young of the walrus and the whale. The bear of course never attacks the full-grown whale; because the weapons with which he is furnished are not capable of inflicting any vital injury upon it, while the blow of its tail, even on the water, would flatten him like a pancake. He would attack it at a disadvantage too; for, though he can swim for many miles, he is, like all quadruped animals, very powerful only when he has a firm support. He does however often attempt, and sometimes captures the young of the whale, while they are so small that he can drag them on the ice. But this a perilous meal for him; for the whales which he is able to land on the ice are sucking whales, and the mother is generally very watchful of them. The mother can either carry the young one away, far faster than the bear can follow, or she can fight boldly in its defence; so that it becomes food for the bear only by stratagem. The walrus is much more an ice and rock animal than the whale; but still the walrus is never so far from the water as that it cannot easily regain that element; and it has much more command of itself there, and is furnished with tusks so powerful, that though the bear sometimes ventures to measure his strength with it, he seldom gains the mastery. The young of the walrus is, however, often caught by him; but still the seal is his staple food, and it is very abundant. The number of seals in some parts of those northern seas, especially about Jan Mayen and Cherrie Island, is beyond what would readily be supposed; and it is in the vicinity of those islands that the largest bears have been seen.

It is not improbable that the whale fishery in the Arctic Sea may have given an artificial character to the polar bear in the summer, or at all events it has brought him into places where naturally there would be much less to tempt his presence. The smell of the ships, the offal which the crews cast upon the water and the ice, the "kreng" of whales, are all calculated to entice an animal which can smell at so great a distance as this bear. Thus these animals may range further upon the ice than they did before the fishery; and, as there is a new provision of food for them, they may be more abundant than they were once. It is probable too that, about the time of the breaking up of the ice, when there is a general surface current to the south, more of them may drift upon detached boards of ice; and, partly by swimming, partly by walking on the ice, they certainly visit ships in more southerly places than those which they usually inhabit. When they make those visits, they are more bold and daring than when in those places which may be supposed more natural to them; and there are instances when, in these cases, they carry off some of the ships' crews. "A few years ago," says Scoresby, "when one of the Davis's Strait Whalers was closely beset among the ice at the 'south-west,' or on the coast of Labrador, a bear that had been for some time near the ship at length became so bold as to approach along side, probably tempted by the offal of the provision thrown overboard by the cook. At this time the people were all at dinner, no one being required to keep the deck in the then immoveable condition of the ship. A hardy fellow, who first looked out, perceiving the bear so near, imprudently jumped upon the ice, armed only with a handspike, with a view, it is supposed, of gaining all the honour of the exploit by securing so fierce a visiter by himself. But the bear, regardless of such weapons, and sharpened probably by hunger, disarmed his antagonist, and, seizing him by the back with his powerful jaws, carried him off with such celerity that on his dismayed comrades rising from their meal and looking abroad, he was so far beyond their reach as to defy their pursuit."

From the nature of their food the flesh of the polar bears is more rank and fishy, and less agreeable to the taste than that of the land bears, though, with the exception of the liver, which has been found to be poisonous, all the parts of the animal are wholesome. The muscle is whitish, and soft and tender, considering the strength of the animal. The fat resembles tallow, and melts into a transparent oil, which has no offensive smell. The skin is very serviceable as well as handsome for a variety of domestic purposes; and to the northern people it is an article of considerable value. The Greenlanders pull it off entire, and invert it like a sack, into which a person creeps and finds a warm and comfortable bed. The natives about Hudson's Bay dress it to a very pliable consistency. They stretch it on a patch of snow, and stake it down till it is stiffly frozen, then they scrape it till they see the roots of the hair; after which they leave it some time to bleach and dry, and it soon becomes perfectly clean, beautifully white, and very flexible.

The domestic manners of these powerful animals are not much known. The pairing season is understood to be in July and August; and such is the attachment of the pair, that if one is killed, the other remains fondling the dead body, and will suffer itself to be killed rather than leave it. The females retire to their hybernation about Christmas, sooner or later, according to the season. These are often excavated in the snow, and the animals remain dormant in them till about the first of April, when they come abroad with their cubs, usually two in number, which are then about the size of rabbits. She is exceedingly attached to them, and nothing but death itself can put an end to her attentions. When they are mortally wounded, she will fondle them, turn them over, lick them, offer them food, and pay even more tender attention than many human beings; and when she finds that all her efforts are unavailing, she moans most piteously.

The following is one of the many instances of this maternal affection:—

"Early in the morning, the man at the mast head gave notice that three bears were making their way very fast over the ice, and directing their course towards the ship. They had probably been invited by the blubber of a sea-horse, which the men had set on fire, and which was burning on the ice at the time of their approach. They proved to be a she-bear and her two cubs; but the cubs were nearly as large as the dam. They ran eagerly to the fire, and drew out from the flames part of the flesh of the sea-horse, which remained unconsumed, and ate it voraciously. The crew from the ship threw great pieces of the flesh, which they had still left, upon the ice, which the old bear carried away singly, laid every piece before her cubs, and dividing them, gave each a share, reserving but a small portion for herself. As she was carrying away the last piece, they levelled their muskets at the cubs, and shot them both dead; and in her retreat, they wounded the dam, but not mortally.

"It would have drawn tears of pity from any but unfeeling minds, to have marked the affectionate concern manifested by this poor beast, in the last moments of her expiring young. Though she was sorely wounded, and could but just crawl to the place where they lay, she carried the lump of flesh she had fetched away, as she had done the others before, tore it in pieces, and laid it down before them; and when she saw that they refused to eat, she laid her paws first upon one, and then upon the other, and endeavoured to raise them up. All this while it was piteous to hear her moan. When she found she could not stir them, she went off, and when at some distance, looked back and moaned; and that not availing to entice them away, she returned, and smelling around them, began to lick their wounds. She went off a second time as before; and having crawled a few paces, looked again behind her, and for some time stood moaning. But still her cubs not rising to follow her, she returned to them again, and with signs of inexpressible fondness went round first one and then the other, pawing them, and moaning.

Finding at last that they were cold and lifeless, she raised her head towards the ship, and growled her resentment at the murderers; which they returned with a volley of musket balls. She fell between her cubs, and died licking their wounds."

Many other instances might be quoted, illustrative of the character of these singular animals,—animals which are perhaps more characteristic of those dismal regions to which they are confined, than the animals of almost any other region. They dwell, as it were, upon the very verge of the living world, being found as far to the north as the restless foot of human discovery has penetrated; and they are perhaps the only animals not decidedly and habitually inhabitants of the sea, which are found in every longitude, and are in all longitudes exactly the same. We cannot say positively that they range across the pole of the earth's rotation, and pass from Asia to America, and from America to Asia by that route, because there is a zone round the pole of which we have no knowledge. But, as the observations of the recent voyagers for discovery in the Arctic regions, corroborated by some other circumstances, lead us to conclude that the latitude of the magnetic pole (or poles) has the maximum of cold, and that the climate of the pole of rotation is not so severe, we may therefore suppose, without any violent straining of theory, that, in the perpetual day which reigns there for a longer period than in the limits of their habitation southward, the polar bears range over the whole polar zone, till those confines where the sea is too clear of ice for their habits; and that they are thus the only animals which have the command of all the meridians on the globe.

3. The Black Bear (*Ursus Americanus*). The black bear differs from the other species of the genus by having the nose and forehead almost on the same line, though the forehead is rather more prominent. This projection of the front is less apparent at the upper part than in the brown bear of Europe. The palms of the hands and soles of the feet are very short, and the whole body is covered with long, shining, straight, black hair, which is by no means harsh to the touch. The face is marked with fawn colour on both sides, and a circular spot of the same colour is observable in some individuals in front of the eye; others have the muzzle of a shining light yellow, with a white line beginning at the root of the nose and extending to each side of the angle of the mouth. This extends over the cheek to a white space shaded with fawn colour, covering all the throat—it descends upon the breast. The yellow bear of Carolina is also a variety of the black or American bear. Captain Franklin saw adults of this species in the neighbourhood of Cumberland House, which were red, and remarked that the cubs of these red bears were black, while the cubs of the black individuals were as often of a red colour. It is said that the black bear can be also distinguished by its having one more molar tooth than the brown bear. They are found throughout North America, from the shores of the Arctic Sea to its southern extremity. That they must have existed in great numbers throughout this extent of country, before its settlement by Europeans, may be easily believed, from the immense number of skins which can even now be procured of this animal. About thirty-six years ago, one hundred and ninety-two thousand four hundred and ninety-seven bear skins were exported from Quebec; in the year 1822, the Hudson's Bay Company exported three thousand skins of the black bear.

American Black Bear.

On the wooded portions of the rocky mountains, Captains Clark and Lewis saw black bears, and subsequently found them on the great plains of the Columbia, and in the tract of country lying between these plains and the Pacific Ocean. Occasionally they are found throughout the territories of the United States, in the wooded and mountainous regions, and in unsettled districts. Their skins are of great use to the inhabitants as a substitute for manufactured woollens, such as blankets, &c.

Under ordinary circumstances the black bear is not remarkable for its ferocity, nor is it in the habit of attacking man without being provoked. When wounded, he turns on his enemy with prodigious energy and defends himself daringly. During the coupling season, this disposition is more fully shown, as the males are then more excited, and are consequently less lazy and clumsy than they are in the autumn. If this bear is taken when young, it is easily domesticated, and taught many tricks; he is frequently to be seen exhibited by showmen as a "learned" bear; but, poor beast, all grown up children should know enough of natural history to be aware. that these feats are performed by the bear, because he has struggled through a long course of discipline, hard and tortuous, to bring him to this state of supposed improvement. When confined they are remarkable for the persevering manner in which they move backwards and forwards as far as their chain will admit, thus showing their impatience of constraint. This wish for exercise is shown more conspicuously when the animal is confined in a very small cage where he has not room to turn round. Under these circumstances he moves himself in every direction, that his narrow limits will allow by stepping from side to side of his cage, and then, by raising and instantly depressing his body, as if about to leap from the ground, he gives his frame a degree of exercise which tends to the preservation of his health.

In the severe winters at the north, they often have a difficulty in the procuring of their food, they then travel to the southern regions in considerable numbers. In the report of Dr. Sibley, to the secretary of war, relative to the territories bordering on Red River, he states that, from all the information he could gain, immense and almost incredible numbers of these animals descended the mountains and passed southwardly into the timbered country.

In this bear, the sight and hearing seem to be the most acute of the senses as well as in the case of many others of the genus. Although he kills many small animals, he does not follow them by the smell. When walking his gait is heavy and awkward, and when running is not much less so. He, however, in consequence of his strength, moves with great celerity, and sustains himself under the exertion for a long time.

The females bring forth their young in the winter, and exhibit for them a degree of attachment which cannot be surpassed. They generally have two cubs, which they suckle till full grown. The affection existing between the mother and her cubs, appears to be mutual and unchanging. Indeed, this never-varying regard shows the instinctive propensities of the brute creation in a very remarkable degree, as nothing short of absolute destruction can separate the mother from the cub, or the cub from the mother.

A friend of Dr. Godman's, while traversing a wood near Fort Snelling, on the Missouri, saw a she-bear with two cubs (about the size of puppies at a month old) a short distance before him. The cubs immediately ascended a tree, and the dam, raising herself on her hind legs, sat erect at its foot in order to protect them: the rifle, discharged with a fatal aim, laid the parent lifeless on the earth. The hunter then approached and stirred the body with the butt of his gun, on which the little cubs hastily descended the tree and attacked him with great earnestness, attempting to bite his legs and feet, which their youth and want of strength prevented them from injuring. When he retired to a short distance, they returned to the dead body of their dam, and by various caresses and playful movements, endeavoured to rouse her from that sleep "which knows no waking."

Black bears are still numerous in the wooded and thinly settled parts of Pennsylvania, as well as in most of the other states of the Union. Where their favourite food is plenteous they grow to a vast size, and yield a great quantity of oil. Barham says that he was present at the cutting up of one which weighed five or six hundred pounds, and his hide appeared as large as that of an ox of six or seven hundred weight.

The food of this animal is chiefly sweet fruits, bramble and other berries; it is also fond of the acorns of the live oak, on which it grows very fat in Florida and elsewhere. In procuring these acorns they often place themselves in very perilous situations. In climbing the large oak trees, they push themselves along the limbs towards the extreme branches, and with their fore paws bend the twigs within their reach, in doing which they often expose themselves to fatal accidents. They also eat a variety of nuts and esculent roots, and often make long excursions in quest of whortle berries, mulberries, and all finely flavoured and spicy fruits. Birds, small quadrupeds, eggs, and insects, are greedily devoured by them whenever they can be obtained. The frontier settlers do not like them at all, as by their incursions in quest of young corn and potatoes, they often commit great devastation; their claws enabling them to dig up a great number of potatoes in a very short time; and where the bears are numerous the damage they commit is very extensive.

In the north, the flesh of the black bear is considered in high perfection after the middle of July, when the berries begin to ripen, though some berries impart a very disagreeable flavour to their flesh. They continue to be in good condition till January or February; later in the spring they are much wasted, and their flesh is sapless and disagreeable; probably in consequence of their long fasting through the season of their torpidity. Their flesh is also rendered rank and unpalatable by feeding on herring spawn, which they devour with the utmost greediness. At all seasons of the year, the southern Indians kill great numbers of these bears, but no inducement will prevent them from singeing the hair off of all that are in good condition for eating, the flesh of the bear being as much spoiled by skinning it as pork is. The skins, therefore, that these people dispose of to the traders, are those of bears that are too poor for being eaten.

The black bear in the vicinity of Hudson's Bay has been observed, in the month of June, to feed entirely on water insects when the berries are not ripe. These insects, of different species, are found in immense quantities in some of the lakes, where they are driven by gales of wind in the bay, and being pressed together in vast multitudes, they die. The odour which arises from this mass of putrefaction is intolerable. In some places they lie two or three feet deep. The manner in which they catch these insects is by swimming with their mouth open, and thus gather the insects on the surface of the water: when the stomach of the animal is opened at this season, it is found to be filled with them, and emits a very disagreeable odour. They are said to feed on those which die and are washed on shore. The flesh of the animal must be much spoiled by this diet, as individuals killed at a distance from the water are well flavoured at the same time of year.

The black bear is in fact very indiscriminate in his feeding, and though suited by nature for the almost exclusive consumption of vegetable food, yet when pressed by hunger, he refuses scarcely any thing. He is voracious as well as indiscriminate, in satisfying his appetite, and frequently devours so much, that his stomach loathes and rejects it. He seeks, with great assiduity, for the larvæ or grub-worms of various insects, and exerts a surprising degree of strength in turning over large trunks of fallen trees, which, if sufficiently decayed, he tears to pieces in search of worms.

During the season when the logger-head turtles land in vast multitudes from the lagoons at the south, for the purpose of depositing their eggs, the black bears come in great numbers, and dig them out of the sand with so much expedition, that the turtles have scarcely turned their backs when the bears have feasted to excess upon their eggs.

West of the Missouri, the black bears are observed to feed most commonly on grapes, plums, dog-wood berries, and other fruits that lie in their way, and they are frequently to be seen contending with the wolves and the buzzards for pre-eminence in feasting on carcasses that have died by disease, or have been abandoned by the hunters. When the bear seizes a living animal, he does not put it to death, but, regardless of its struggles and its screams, he tears it piecemeal, and, disdaining its torture, eats it while the flesh is quivering with convulsive agony.

It has been asserted that the black bear is not a "flesh-eater." But this is not the fact, as this bear is well known to feed on flesh, even to the rejection of fruits. When pressed by extreme hunger, they will even kill pork for their own use.

The usual retreat of the black bear is in the most remote and secret parts of the forest, where his den is in the hollow of a decayed tree, or in a cavern formed among the rocks. He retires to this place when his hunger is appeased, and in the winter he lies coiled up there during the long period of his torpidity. During the period of gestation, which commences in the month of October, the female of the black bear leads a retired and solitary life for the whole period, which is about one hundred and twelve days. We have no instance on record of a bear in a state of pregnancy being killed, though the mother and very young cubs are frequently destroyed.

In the northern part of the American continent, the subterraneous retreats of the black bear may be easily discovered by the mist which uniformly hangs about the entrance of the den, as the animal's heat and breathing prevent the mouth of the cave from being entirely closed, however deep the snow may be. As the black bear usually retires to his winter quarters before any quantity of snow has fallen, and does not again venture abroad till the end of March or the beginning of April, he therefore spends at least four months in a state of torpidity, and without obtaining food. It is therefore not very surprising, though the bear goes into his winter quarters excessively fat, that he should come forth in the spring a melancholy picture of emaciation.

The black bear is sometimes destroyed by blocking up the mouth of the cave with logs of wood, and then suddenly breaking open the top of it, they kill the animal with a spear or gun; this method is, however, considered both cowardly and wanton, as the bear can neither escape nor offer the slightest injury to his merciless destroyers. The northern Indians display great ingenuity in the manner in which they throw the noose around the neck of this animal, but the barbarous way in which they despatch him with the hatchet or tomahawk, after having drawn him to the top of his hole, has little in it to admire.

Sometimes he is caught in traps, strong steel ones chained to a tree and laid in a path which has been partially stained with blood, by drawing a newly-killed carcass along it. At other times, a noose, suspended from a strong bough, is substituted for the trap, in a path similarly prepared. The bear, whose sense of smell is exceedingly keen, always follows upon the track along which a dead animal has been drawn, even although it has left no trace perceptible by the human senses.

The common mode of hunting this bear is by two or three well-trained dogs. When he finds that he is pursued, he generally pushes forward for eight or ten miles, and sometimes more, in nearly a straight course. But when the dogs come up to him, he turns and strikes at them with his paws, the blows of which are so severe, that one of them taking effect, would instantly fell the strongest dog to the ground. The great art in training the dogs consists in teaching them to avoid these blows, and keep harassing the animal till he is exhausted. When that is the case, he climbs a tree to the height of twenty or thirty feet, at the root of which the dogs remain and "give tongue" till the hunter makes his appearance. When the hunter appears, the bear drops to the ground, not for the purpose of attacking him, but of making a new effort at escape from the now increased number of his pursuers. But, as he is heated by the effort of climbing and by the fall, though bears, from their form and also the nature of their covering, fall with much less injury than any other animals of the same weight, he is much more annoyed by the dogs than before. This makes him take to a tree again for refuge, he then climbs as high as it will bear him, and endeavours to conceal himself among the thick foliage. The hunter now strikes against the trunk of the tree as if he were felling it, which soon puts the bear in motion. He makes his way to the extremity of a long and lofty branch, at which he draws himself partially into the form of a ball, and drops down, often from such a height as that he rebounds up again for several feet, as if he were an elastic substance. He rises again from this fall, still uninjured, and seeks safety by flight as before. His exertions are, however, so much greater than those of his pursuers, that, whatever may be his strength, they in time wear him out, and he is ultimately shot, either when standing up to give battle to the dogs, or when attempting to hide himself behind the trunk of a tree. Such is the mode of bear hunting where there are trees; but in the large open prairies he runs much farther, and the hunt is one of greater ardour, unless when he is shot at an early stage; but, if the marksman is not skilful, shooting is rather a dangerous matter while the bear is unexhausted, as the pain arouses all his strength, and arms him with the most desperate powers of revenge, so that he would be too much both for dogs and hunter.

The Indians consider the black bear as the most valuable of wild animals, and the chace of it as their noblest field sport, its death being always followed by expressions of the greatest exultation. It is, indeed, highly useful to them; and, like the ox and the sheep, there is no part of it which is not applied to some purpose. The flesh is highly esteemed, and the paws are reckoned the richest *bonne bouche* that the wild forests of America afford. The skin furnishes their softest couch, and their most substantial protection against the severities of the winter. Even the claws have their value: they are bored and strung upon the tendons of deer, to be worn as necklaces and other ornaments.

In the early part of the season the bear is not much hunted, because it is then lean, and both more fleet and more ferocious than after it has become fat. The fat of course continues accumulating up to the time when the bear retires to its winter retreat, and the males, which are killed after the disappearance of the greater number of the females, are both in finest fur and "highest grease." The grease or fat collects in great quantities on various parts of the body; and a very limpid oil is obtained from it.

This bear is very tenacious of life, and as he stoutly defends his grease to the very last extremity, it is dangerous to touch him, unless he is shot directly through the heart or the brain. A skilful hunter never advances upon him without taking the precaution to reload his rifle, as the bear often springs up instantly and fiercely from a state of apparent death. Shooting through the brain can be accomplished only when the distance is short, and the bullet hits directly, for the skull is so strong that an oblique shot is sure to graze; and bullets have glanced off flattened from the skulls of bears when discharged from a rifle at the distance of ninety yards, without apparently having injured the bone. At close quarters the blows of a blunt instrument have little effect upon the body, or even the head of the bear, unless he is hit on the snout, upon which a moderate blow will stun and stupify him. This is easily accounted for, from the exceedingly acute sense of smelling in the animal, and the necessary abundance of nerves in and about the nostrils. It is worthy of being borne in mind, as one means of defence against wild animals generally, that if the animal is remarkable for the superiority of any one sense, the organ of that sense is always the most vulnerable part.

A sharp instrument, which is used with a short grasp, requires very skilful management at close quarters with the bear; and those who rashly attempt to assail him with such a weapon often pay dear for their temerity. If, however, a man has sufficient presence of mind, and can keep his arm disentangled, he can master the bear even at its own favourite practice of hugging, as he has only to grasp the animal's windpipe as tightly as he can close by the root of the tongue, and hold it determinedly, in order to make the bear almost instantly relax his clutch, and speedily part with that life which he maintained so desperately against wounding. Thus, in the case of this animal, as in most other cases, a very little skill, used with coolness and self-possession, succeeds far better and more speedily than the most powerful exertion of mere strength.

4. The Grisly Bear (*Ursus horribilis*). A very characteristic delineation of this bear is given by Landseer, in the plate "Bears," (No. II.) It is described as the largest and most formidable of American bears, and indeed of all land bears; and the character of its habitation points out the purpose which bears answer in the grand system of nature. The whole genus, as already noticed, have a polar rather than an equatorial character, and may thus be considered as geographically the reverse of the more formidable among the strictly carnivorous animals—the lion and tiger in the eastern world, and the jaguar in the western. These are all tropical in their home, habitually ardent in their temperaments, and, though they can endure hunger for considerable periods, they feed all the year round, and thus have no season of repose. The bears again are seasonal animals, retiring during the winter, and coming abroad in the spring. But it is not from the storm that the bears retire, it is from the cold serenity—the almost total cessation of atmospheric as well as living action which reigns during the polar winter: the storm is both seed time and harvest to the bears. During the utmost of its fury they range the wilds and forests, accompanied by those more powerful owls and hawks, which, like the bears, are equally remarkable for their strength and their impenetrable covering. At those times many of the smaller animals are dashed lifeless to the earth by the storm, or shrouded in the snow, and upon these the bears make an abundant supper—a supper of days, and even of weeks, before they retire to their long rest. So also, when the storm begins to break, they find a plentiful collection of the carcasses of such animals as have perished in the snow, and been concealed from sight, and preserved from putrefaction under it.

The devastation is of course much greater, because the storms are more severe among the mountains in North America, than on the plains or in the forests of the valleys. Those mountains are not very lofty, but they are exceedingly wild and rugged, presenting rocks and precipices of more harsh and ragged character than are to be found to the same extent in any other part of the world. It is for this reason that they have gotten the name of the "Stony Mountains," and that name is peculiarly appropriate.

These stony mountains are the habitation of the grisly bear, which was an animal unknown to natural history until inquiry and observation had been extended to that side of the great central valley of which they formed the boundary; and that this bear, which is their proper inhabitant, should be the most powerful and the most ferocious of land bears, shows that the energy of these animals is ever in proportion to the waste of nature which may be supposed to take place in the region which they inhabit. The most formidable of the equatorial preyers inhabit lower down—the lion in the thicket, and the tiger in the jungle; but, as is proved by this species, the bear of the mountains is much more formidable than the bear of the plains; and we have a collateral proof in the land bear of Europe and the north of Asia, which invariably becomes more of a mountaineer the farther that it extends into southern latitudes.

Dr. Godman, to whose valuable work on the Natural History of America we are indebted for a good practical account of the bears of that part of the world, thus characterises this formidable animal: "This bear, justly considered as the most dreadful and dangerous of North American quadrupeds, is the despotic and sanguinary monarch of the wilds over which he ranges. Gigantic in size, and terrific in aspect, he unites to a ferocious blood-thirsty disposition a surpassing strength of limb, which gives him undisputed supremacy over every other quadruped tenant of the wilderness, and causes man himself to tremble at his approach, though possessed of offensive weapons unknown to any but the human race. To the Indians the very name of the grisly bear is dreadful, and the killing of one is esteemed equal to a great victory; the white hunters are always willing to avoid an encounter with so powerful an adversary, and seldom or never wantonly provoke his anger." We are informed by the same authority that this bear, when excited by hunger or passion, pursues, attacks, and slaughters indiscriminately all animals which are unable to escape from him by speed or by artifice; and that even the American bison, which is an animal of great strength and power, is vanquished by this bear, and its heavy carcass dragged along with the greatest ease to a place where it can be consumed at leisure.

Independently of its size, its colour, and the ferocity of its disposition when roused, this bear may be readily distinguished from every other species, by several well-marked characters. The line of its forehead and muzzle is straighter than in any other species, and its claws, especially those of the fore feet, are much more produced, and far more crooked, though its general habit is not that of a climber. The snout is black, and moveable; the central furrow being distinct; the lips are partially extensile; the eyes very small, having no third eyelid, and the irides being of a light reddish-brown. The ears are short and rounded, and the line of the forehead thence to the eyes is a little convex, but it continues straight to the point of the snout. The hair on the face is very short; but on the body generally it is long and very thickly set. When young, its general colour is not unlike that of some varieties of the brown bear of Europe. Like that too it is subject to considerable variations of shade, not only from age and season, but also in different individuals. But when full grown, the prevailing colour of the body is a mixture of white, brown, and black, from which they have received the epithet of grisly; but the legs, the feet, the shoulders, the throat, the belly, and hinder parts of the thighs, are darker and more inclining to black than the rest of the body, while the snout, so far as it is covered with hair, is paler. The tail is very short, and in the living animal, completely hidden by the hair.

On the fore-paws, the claws are rather slender, but long, as well as crooked, and sharp at the tips, though the sharpness is rather that of a chisel, by being narrowed at the sides, than a point. This structure gives the tips of them great additional strength, and accounts for the severe gashing wounds which are inflicted by their stroke. The toes of these paws are furnished each with a sub-oval naked tubercle, and the anterior half of the palm is also naked, and of an oval shape, placed lengthwise across the palm; while the anterior part has a rounded naked tubercle. The interstices of these tubercles, and also between them and the claws, are covered with thick and strong hair. The soles of the hind feet are also in great part naked; and the claws on them are considerably smaller than those on the paws, though much more crooked; and their trenchant points form very terrible lacerating instruments when the animal closes with its enemy in hugging. They are sufficient to tear the abdomen of even a large animal to shreds, while the fore-paws are at the same time compressing its thorax to suffocation.

The size of this species varies considerably. The statement made by the Indians, that some specimens are fourteen feet long, must be regarded as an exaggeration to probably double the actual size; though one specimen killed by Lewis and Clark and their party on the banks of the Missouri, measured eight feet seven inches and a half from the nose to the extremity of the hind legs when extended. The length from the nose to the tail, which is the usual measurement of an animal, is not mentioned in this specimen; but it cannot have been more than between five and six feet; and five feet two inches is the length of those in the museum of Philadelphia. The girth round the breast of that mentioned by Lewis and Clark was five feet ten inches and a half; and that round the middle of the fore-leg three feet eleven, a size far exceeding that of the paw of the lion, and giving sufficient reason to believe that the paw of this bear is probably the most formidable striking instrument possessed by any kind of animal, and in all the departments of nature surpassed only by the tail of the whale. The want of clavicles, and the consequent freedom of motion in the shoulder, which enables the animal to add the blade-bone to the lever power of its paw, greatly increases the effect of its murderous stroke. The claws on the specimen alluded to were four inches and three-quarters in length. Its weight, though inferior to that of the larger specimens of the white bear, was between five hundred and six hundred pounds, so that altogether he was an animal of giant strength.

It does not, however, appear that he seemed inclined to use that strength like a giant, at least against the party; for when they fired at and wounded him, he showed no disposition to attack them, as is generally the case with the less formidable black bear, but made off with a tremendous roar; and such was the power of life in him, that, though five balls had passed through his lungs, and an equal number of gun-shot wounds had been inflicted on other parts of his body, he swam more than half way across the river to a sand-bank, and lived for more than twenty minutes.

The shooting of this animal by a single hunter is both a dangerous and a difficult matter. One shot will not kill, or even for a long time disable him, unless it directly penetrates either the heart or the brain. The former of these is much protected by the thick hair, the strong muscles, and the stiff ribs; and the latter by the equally strong muscles on the side of the head, and the firmness of the skull, which is impenetrable to a rifle-bullet at any moderate distance, unless that bullet takes effect perpendicularly to the surface.

But notwithstanding the formidable weapons and vast strength of this animal, it does not appear to be in accordance with his general habit to use them for murderous purposes; and the character of ferocity which has been so liberally bestowed upon him by hunters and travellers, appears to be, like the savage character given by showmen and bear-wardens to the brown bear of Europe, the result of their own cruel treatment, rather than of any instinctive propensity in the animal. Thus the trivial name "*horribilis*," which has been given to it by the Americans, though, as the original specific appellation, it must be allowed to stand, is yet an exaggerated name, and savours not a little of that love of amplification which never suffers a man to fall accidentally from a height of less than a hundred feet, or jump a chasm, the jaws of which are not half that distance asunder.

In the formation of its teeth, the grisly bear has no more carnivorous character than the mildest of the other land bears; and if we are to suppose that the number of false molars, which are small in size and speedily fall out, any indication of an uncarnivorous character, this species should have that character in greater perfection than any of the others, inasmuch as it is furnished with a greater number of those teeth.

That the grisly bear is a vegetable feeder as long as vegetable food can be found is unquestionable; and if its economy in its wild state could be observed calmly and without hostility, there is as little doubt that it would be found, even when vegetable food fails, not to attack any living animal, as long as it can find out, by its keen sense of smelling, the carcass of a dead one. The constitutional character of the genus, as has been already mentioned, is, in so far as it is carnivorous, to destroy the remains of life rather than life itself. In physical nature, the whole race are in their locality, and consequently in their habits (for locality and habit are always in keeping with each other) allied to the destroying powers, and not to the productive ones; and therefore it accords with the analogy of nature that we should find them removing the effects of the havoc which destruction has made, in preference to being in themselves constitutional and primary destroyers.

As has been mentioned of the brown bear of Europe, and as seems to be true of all the genus, with the exception perhaps of the white bear, whose habits are more aquatic than terrestrial, and therefore not suited to domestication by man, the young of the grisly bear might be tutored without much difficulty.

No inference to the contrary of this can be drawn from the accounts of the two which were in the museum at Philadelphia, and had to be killed because of their ferocious disposition. Every one who has observed the difference of character between the same watch dog in the chain and in a state of freedom, must feel convinced that confinement is not the specific for softening the disposition of any animal; and the two bears in question were caged. Whether they were "stirred up with the pole," as is usual in the ease of show bears, is not mentioned, neither is it denied.

These bears were taken in rather a southern latitude among the Stony Mountains; and they are said to have been littered about the 1st of March, 1807 (which, by the way, shows that this species produces later in the year than the brown bear). They were so young that they could take only milk; and in that state they were carried a long distance. Pike's account of their conduct on the march, shows both how they might have been tamed, and how they were not:—"I had a cage," says he, "prepared for both, which was carried on a mule, lashed between two packs; but I always ordered them to be let out the moment we halted, and not shut up again till we were prepared to march. By this treatment they became exceedingly docile *when at liberty*, following my men like dogs through our camps, and the small villages and forts where we halted. When well supplied with sustenance, they would play like young puppies with each other and the soldiers; but the instant they were shut up and placed on the mule, the beeame cross, as the jolting of the animal knocked them against each other, and they were sometimes left exposed to the scorching heat of a vertical sun for a day without food or a drop of water, in which case they would worry and tear each other, till nature was exhausted, and they could neither fight nor bawl any longer."

The following is the account of their conduct in the museum:—"When first received they were quite small, but speedily gave indications of that ferocity for which this species is so remarkable. As they increased in size they beeame exceedingly dangerous, seizing and tearing to pieces every animal they could lay hold of, and expressing extreme eagerness to get at those accidentally brought within sight of their cage, by grasping the iron bars with their paws and shaking them violently, to the great terror of spectators, who felt insecure while witnessing such displays of their strength. In one instance, an unfortunate monkey was walking over the top of their cage, when the end of the chain which hung from his waist dropped through within reach of the bears; they immediately seized it, dragged the screaming animal through the narrow aperture, tore him limb from limb, and devoured his mangled carcass almost instantaneously. At another time a small monkey thrust his arm through an opening in the bear cage to reach after some object; one of them immediately seized him, and, with a sudden jerk, tore the whole arm and shoulder blade from the body, and devoured it before any one could interfere. They were still cubs, and very little more than half grown, when their ferocity became so alarming as to excite continual apprehension lest they should escape, and they were killed in order to prevent such an event."

Upon comparing the account of the soldier, who had no "story" to tell but simply the truth, with that of the Museum describer, in regard to these the same animals, it cannot fail to strike the reader that there is a wonderful coincidence between these and the accounts of similar parties respecting the common hyæna. Every one who knows anything about domestic economy in the Dukhun, must be aware that the domestication of the hyæna as a substitute for the dog is a very common occurrence there; and the memory which the hyæna at the Zoological Gardens retained of the kindness of colonel Sykes, after the lapse of two years, and the apparent joy with which it welcomed him though he gave it nothing, are interesting traits in the animal economy. Yet this same hyæna has, "time out of mind," been the "ferocious and untameable"—the very ultimate example of unrelenting cruelty.

Some of the habits of the bears and the hyæna are similar: for instance, they both consume dead carcasses; but otherwise, the hyæna is by much the more carnivorous animal of the two, especially in the structure of its teeth; and therefore the accounts of the untameable disposition of the one animal are no more deserving of rational credence than those of the other.

We have no intention of pleading specially for the grisly bear, or for any animal whatever; but, though it is nearly exploded among all who *study* natural history, there is a great deal of the ridiculous exaggeration introduced by the showmen, still current in the country and in so far perpetuated by compilers; and this remaining delusion it becomes our duty, writing as we do for the public, by every means in our power to dispel. It is also our duty to mention, for the sake of those who have not the opportunity of seeing animals in a state of nature, or in that semi-freedom which they enjoy in zoological gardens, that, in the pigeon holes of a travelling caravan they see only the dwarfed or the emaciated forms of the animals, and nothing whatever of their natural dispositions. Indeed, if the gentlest mouthpiece of the menagerie that ever told the terrors of a tiger to the wondering rustics at a fair, were to get only twelve months of the tenement and treatment of his beast, he would be the more ferocious animal, and therefore the better spectacle of the two.

But while we must not judge of the character of the powerful bear under notice from the museum account, as little can we do it from the aecounts of the hunters; for if the one shows us an animal soured and irritated by captivity, the other displays it with all its formidable energies aroused in defence of its life. Of these accounts by the hunters we shall, however, give the substance of one instance from the expedition of Lewis and Clark on the Missouri. One evening, the men in one of the hindmost of the canoes perceived a grisly bear lying on the open ground about three hundred paces from the river; and six of them, good hunters, went to attack it. They got within forty paces unperceived, when four fired, all hitting, and two balls passing directly through the lungs. The bear sprang up and ran furiously at them with open mouth, upon which the two hunters who had reserved their fire, gave it, both hitting, and one breaking his shoulder blade, which somewhat retarded his motions. But before they could reload, he came so close upon them that they were obliged to make directly for the river, and before they reached it the bear was almost within paw's length. Two jumped into the canoe, and the other four, concealing themselves among the willows, fired as fast as they could load. They struck him several times; but that only made him proceed more furiously in the direction whence the wound came.

At last they were obliged to throw down their guns and pouches, and jump from a bank twenty feet high into the river. But bruin is more expert both at jumping and swimming than even a back-woods' rifleman, so he plunged in after them, and was almost in the act of seizing the hindmost man, when one of those on shore shot him through the head and he expired. When they dragged him on shore, they found that eight balls had passed through his body in different directions.

There are many similar occurrences mentioned, but notwithstanding them all, the real character of this animal does not appear to be made out in a manner altogether satisfactory; and thus, like most objects while seen through a fog, this monster of the American wilderness may appear much less formidable when we come to closer inspection.

Though the black bear and the grisly bear are the only two species of North American bears that have been definitely ascertained, the former as an inhabitant of the low ground forests, and of these only or chiefly, and the other as an inhabitant of the mountains, or at least more upland as well as more southerly than the other; yet it is not improbable that there is a third species, more resembling the common bear of the eastern continent than either of the others. This species prowls about in the open wastes; and therefore it has been styled

5. The Barren Ground Bear (*Ursus arctos Americanus*). Whether there is any structural distinction between this and the other American bears, has not been very clearly ascertained. Indeed the structural distinctions of bears differ much less than those of almost any genus; the chief ones, colour and size apart, being the facial line (which is not indented at the eyes in the American species), and the greater or less production of the hair and claws, the former of which may be the effect of climate, though it is not easy to see how climate could produce the latter. The bears which are found on the barren plains (that is, the woodless districts) of North America, are lighter in the colour than the climbing bears of the woods; and the Indians, who are their principal historians, represent them as being much more ferocious and dangerous. In this respect there is no reason to doubt the testimony of the Indians; but the ferocity may in part arise from the greater excitement to which the animals are exposed in those open places.

That bears become torpid when the temperature sinks to a certain point, shows that they are, notwithstanding the thickness of their covering, very sensitive to the action of the weather; and the bears in question are much more exposed both to common atmospheric action and to light, than those which inhabit the woods. It is therefore natural to suppose that, during the summer at least, their system is in a state of higher and more constant excitement; and if this be true, and it certainly is true, of the whole system, it must be true also of the appetite for food; and as those bears have to range more in quest of their food than the woodland bears, that again must increase their activity, and consequently their voracity. They thus, in some measure, approximate in character to the polar bear; and partially also to the grisly bear of the mountains, which is more a ground hunter than a climber.

Bears of this description prowl much on the shores of the northern sea, and divide the spoil with the white bears. One mentioned by Dr. Richardson, had in its stomach portions of a seal and a marmot, and also some grass and berries, showing that, in this instance, bruin had dined in style—having two courses with vegetables and a desert; and though the seal cannot strictly be considered as fish, yet being a marine animal, it may pass muster as a substitute. This compound shows, at all events, that these bears are pretty ravenous as well as miscellaneous in their feeding. Still it is not very probable that they will attack human beings unless very much pressed with hunger, unless indeed those by whom they are seen endeavour to escape by flight.

It is this last circumstance which renders the bear so dangerous an animal to those who are not well-armed with weapons, and especially with presence of mind. It has been stated in the case of some other animals, and it is confirmed in this, that flight in the prey is one of the main causes of pursuit in the preyer; and though it is doubtful whether any of these bears ever unprovokedly attacked a human being when advancing upon it, there is little doubt that they will follow, and endeavour to capture either man or animal when they seek safety by flight. When Mr. Drummond was botanising among the wild rocks in the northern parts of America, he sometimes, at the turning of a rock, found himself almost close upon a grisly bear; but Drummond is as remarkable for presence of mind and philosophical courage as for love of science, and therefore he outfaced bruin without irritating him; and when the bear found that Mr. Drummond would neither fight nor fly, he took to his heels, and left the naturalist master of the field. If he happened to see them at greater distance, he got rid of them more readily, by simply drumming on the tin box in which he carried his specimens. This, though we believe it happened chiefly with the grisly bear, may be considered as the general character of all the species, and of course of the barren-ground bear among the rest.

It is worthy of remark, and not of remark merely, but of careful investigation and study, that there appears to be in the north-east of Europe, and more especially in the north of Asia, a species, or variety, or modification of the land bear, very similar to the American one now under consideration. Like that, it is found chiefly to the northward of the woods, near the margin of the sea, bordering closely with the white bear, and approximating somewhat to that bear in colour, and, as it is said, in disposition. The data are not sufficient for determining whether this intermediate bear is or is not entitled to systematic distinction as a species: but whether it be species or not, its existence is established by the testimony of those who range the plains which it inhabits, and its character, and the characters of those places, appear very much to resemble each other in the two continents, if they are not perfectly identical, at least in so far as the animals are concerned.

This is a point of some importance in natural history, inasmuch as it shows that there is perfect identity, or acknowledged sameness of species, in those bears which inhabit nearest the pole; and that as we proceed southward the resemblance between those of the two continents becomes less and less. At the same time there is a departure from the appearance of the polar bear, though the species of corresponding climates have still some resemblance to each other. The colour is first pale brown; then it passes to soot black; the latter continues as the prevailing colour in the bears of warm countries, but they have the hair shorter and more glossy, and some markings of brighter colour, especially about the head. It will, however, require much observation before the gradations of the species can be distinctly traced, and the causes by which they are produced clearly seen. It is certain, however, that one species of bear inhabits round the whole globe in the arctic regions, and is the northernmost of the genus; and that as the latitude lessens, the bears of both continents vary in their characters from those common to the two, and each series also assumes distinctive characters of its own.

6. The Spectacled Bear (*Ursus ornatus*). This is the tropical bear of the American continent; and it has received the specific appellation of *ornatus*, or ornamented, from the markings on its head, especially those round the eyes. These are circles of bright brownish yellow, which encompass the eyes and are generally united by a small arch on the lower part of the forehead, which gives them very much the shape of a pair of spectacles. It does not appear, however, that these markings are constant; for, of two specimens at the gardens of the Zoological Society, one has the spectacles quite perfect round both eyes, but in the other one eye only has the mark round it. This shows, by the way, that the peculiar markings of colour which may be said to distinguish the bears of warm countries from those of cold and temperate ones, are not invariable in the species, and cannot, on that account, be received as specific characters.

This species is found in the Andes; and though it has not been traced all the way, and is not indeed abundant or very frequently seen, it appears to take up the mountain range where the locality of the grisly bear ends. Its history is very imperfect; but it appears to be much more exclusively vegetable in its feeding than the bears of the north; indeed, in all longitudes bears seem to get milder in character as they inhabit nearer the tropics; and while the polar bear, and those bears which inhabit the plains on the shores of the polar seas, are to a great extent carnivorous, or at least feeders upon animal matter, as we proceed southward we find them more mild in their characters, and less given to consume animal food. They are also smaller in size, feebler in their structure, and their covering is less shaggy. Even they, the most tropical of them, are not handsome animals; but they are certainly not so ragged and formless as the bears of the north. All this tends to prove what we have already assumed,—namely, that the whole genus are naturally and properly polar animals; and that the influence of improved climate produces an effect on their peculiar characters. The reverse is the case with the carnivorous animals, properly so called; so that there seems to be a little inconsistency in classing them together in the same order. The proper function of the carnivorous animal is to restrain the exuberance of living creatures; and it is with great difficulty that they can subsist upon vegetable matter. The bears upon the other hand, seldom kill; and those of tropical countries subsist chiefly upon vegetables. This in a great measure accounts for their greater mildness of character there than in those parts of the world where necessity compels them to be more predatory.

The annexed figure will give a general idea of the form of this bear, which perhaps approximates more nearly to some of the varieties of the black bear than to any other of the American species. The chief difference is in the peculiar marking on the face of this one; and it has been mentioned that many of the black bears have the rudiments of this marking, in the brownish-yellow spots over the eyes, and in this species the circles, as has been said, are sometimes wanting. This one is, however, only a recent addition to natural history, and its manners, and the extent to which it inhabits the Andes, are but imperfectly known. No mention is made of it as found in the mountains of Patagonia, or even in Chili; neither has it been met with on the mountains of Brazil, or in any other of the detached ridges which are inferior to the Andes in height. As is the case with the bears of all tropical countries, its fur is short, and, consequently, its skin is not so much furzed as that of the northern bears. There is also reason to suppose that it does not accumulate fat to nearly the same extent; and that, taking it altogether, it is a much less important animal, both in the natural history of its locality and in the domestic economy of the people.

Spectacled Bear.

Either there are different species of bears in the Andes, or the one species is subject to considerable variations, at least in colour and in size. Sir R. K. Porter, in a letter to the secretary of the Zoological Society, dated Caracas, Aug. 14th, 1833, mentions one then living in that city, which differs in the markings on the face from any of the individuals which had been previously examined or described by Europeans. The yellowish-white of its face begins on the bridge of the nose, between the eyes, and describes under each eye a semicircle, whence it extends over the whole muzzle, taking rather a greyish hue until it ends in pure white, covering the whole throat and chest, and forming a point between the fore legs. The rest of the animal is jet-black, the hair being silky and shining. It is smaller by far in size than the bears of the northern countries of Europe, and is more compact in form.

The account of this specimen, with the variations that have been seen in others of the few which have been examined, show that it is necessary to observe much caution before any positive conclusions are come to with regard to the specific arrangement of the bears of warm climates. Even in the temperate and the cold latitudes, bears are very sensitive to variations of situation and climate, even when these are not so considerable as to affect almost any other species of animal; and therefore we may naturally conclude, that in a situation like the Andes, where there are all descriptions of climate within a very short distance of each other, the variations of these sensitive animals must be correspondingly great; so that before we can decide what is a different species, and what a mere climatal variety, we must know much more of the history of the animals, in different localities, and in the successive periods of their age. Even the teeth of bears form a much less certain character, at least in so far as species are concerned, than those of most of the mammalia; for not only are the false molars liable to drop out at different ages, but it is doubtful whether there be not also differences in the number of incisive teeth, in species which are in other respects exactly the same.

This caution is necessary, not with regard to the bear, or bears, of the Andes only, but also with regard to those of the south-east of Asia. Of these there are usually reckoned four species,—the Nepâl bear, the common bear of India, the jungle bear, and the Malay bear, and as these seem to vary just as much as those of central America, there is little doubt that, by procuring them of different ages, and from places differently situated, each of these might be multiplied into two or three species more; whereas, if they were reared alike for two or three successive generations, and then compared at the same age and in the same condition, it is highly probable that they might turn out to be all of the same species. These circumstances, together with the very little which is known of the habits of some of them, further than is inferred from the fact of their being bears, render it necessary to be very brief in a popular notice of them.

All these bears have the prevailing colour black, the hair being shorter and smoother, and the markings on the head and throat more conspicuous, in proportion as they inhabit lower down or farther to the south.

7. The *Nepâl bear*, or Thibet bear (*Ursus Thibetanus*). This is a mountaineer, inhabiting the forests and brushes on the slopes of the Himalaya, and pretty generally distributed over that vast mountainous range, though not, as it would seem, from the scanty information which we have of its habits, very numerous in any one place. It is, indeed, doubtful whether there are not more than one species of bear in those mountains, or if there is only one, then that one varies considerably in appearance. That usually described under the specific name which we have given, is rather of small size, and with the feet and claws considerably smaller than those of the northern bears. It is all over of a black colour, with the exception of a large and conspicuous mark on the breast and throat in the form of the letter Y. The profile of this species is much straighter than that of the northern bears; and in this respect it has some resemblance to the bears of America. It is understood to feed chiefly upon vegetable substances, insects, and the bodies of animals which perish in the mountain storms. As the winter is very severe in the upper districts of the Himalaya, it is probable that this species, or at least the females of them, hybernate for a short time. Mention has been made of a bear being seen in the same mountains, more resembling the northern bears in its profile and the texture of its fur, than the species above alluded to, but the account of it is very vague.

8. The Jungle Bear (*Ursus labiatus*). This species gets the name of *labiatus* or "lipped," from the great elongation of the cartilaginous part of its nose, and a similar elongation of cartilage on the extremity of its under jaw. These elongations are moveable, and their consistency is such, that the animal can use them as prehensile instruments, and even manage to divide soft substances with them. Its general colour is black, with the muzzle and the extremities of the feet of a yellowish or greyish-white, and a Y-shaped mark of a similar colour on the throat, with its points forming a demi-collar on the neck.

Jungle Bear.

This species is very subject to lose its incisive teeth through age, and that indeed long before it shows any other symptom of decay; and on this account, as well as from the produced and peculiar form of the muzzle, it has sometimes been described as a sloth, and not as a bear. In all its characters it is, however, a true bear. A disposition to lose the teeth is not confined to this species, but is pretty common among all the bears which inhabit warm countries, or live much upon sweets; and from the injury that we know to be done to the human teeth by an excess of that description of food, we can, in part at least, see the reason of this loss in the bears. The species under consideration lives, as its name imports, in low situations, which are rich and tangled with an exuberant vegetation. It is an expert climber, and not only consumes great quantities of the common succulent fruits which grow so abundantly in India, but readily climbs the cocoa-nut trees, contrives to tear the rind and break the shell of these, and extract the milky juice. In this, and in many other of its modes in feeding, it has little use for incisive teeth, as the cartilaginous lips are sufficient for so breaking or squeezing soft fruits as that the juice of them can be extracted; and the shells of the cocoa-nuts are, of course, broken by the canine teeth.

9. *The common Bear of India*, if a different species from the above, and also from the bears of the mountains, is described as inhabiting places which are rather more dry and open than those inhabited by the jungle bear, though still in the low grounds, rather than in the mountains. It is said to be black and glossy, with the muzzle and throat of a pale-reddish brown colour. It is not of large size, nor in any way ferocious, but feeds much upon those social insects of which the species and the swarms are so abundant in all the fertile parts of India, especially the white ants. It is not understood to be in the least dangerous to man, and indeed none of the bears of warm latitudes

or warm localities can be considered as formidable animals.

10. *The Malay Bear* (*Ursus Malayanus*).—This species is found in the Oriental Archipelago and the Malay Peninsula, and it probably exists in many parts of India. It is but a small animal, the body seldom measuring as much as four feet, so that it is not one-eighth of the weight of the largest specimens of the polar bear. Its feet are smaller, and its legs taper more than those of most bears; but though rather low on the legs, it is a stout animal. The prevailing colour is black; the hair short and stiff, but smooth and shining, except on the ridge of the neck and back, where it is frizzled; the nose, and more or less of the face, is rust coloured, and sometimes inclining to grey; and there is often a spot of a similar colour, more or less conspicuous, over each eye, and another near the corner of the mouth. There is also a crescent-shaped spot of white on the breast or under the neck. The snout is produced something in the same manner as in the jungle bear, only the sides of the production have more the appearance of appendages to the nostrils.

Malay Bear.

The habits of this bear are also very similar to those of the jungle bear. It is a climber, and in a state of nature subsists chiefly upon fruits, and nearly the same sort of fruits as the other. Like that it is an animal of rather gentle manners; but still it is one of great strength, and might, as is the case with all bears, do mischief if irritated. It is, however, very easily tamed, and remarkably docile if duly fed and properly attended to. Sir Stamford Raffles, when in its native country, had a very tame one, which was very fond of eating mangoes and drinking champagne, though it despised wines of less celebrated growth. It played indiscriminately with the children and the dogs, and was withal very gentle and good-natured in its play; but as it grew up it treated the vegetable tribes with less mercy, for when it got into the place where they were cultivated, it used to seize the stems of large plantains with its paws, and wrench them up by the roots.

Such is a very slight outline of at least the prominent species of this very interesting and, in many respects, useful genus of animals. Some of the species that have been mentioned are probably only varieties; and there may be some omitted which future observation may show to be really distinct species. In the present state of our knowledge, however, mistakes both ways are unavoidable, more especially in the case of animals upon which temperature appears to have so much influence as it has upon bears. In those cases mistakes being almost unavoidable, ought not to subject to very heavy censure those who fall into them; but the danger of so falling ought to teach the utmost circumspection in managing the information which we have, and stimulate to the utmost vigilance in acquiring more.

We have treated of those animals at something more than the customary length for several reasons. In the first place, they may be said to extend in latitude over the entire quadrant; and therefore we have the means of observing the effects of all latitudes and all climates upon them. Secondly, they are every where not only animals of wild nature, but of wild nature in a particular state, as regards the soil, the climate, and its productions; therefore their history becomes an index to a considerable portion of the progressive history of the globe. Thirdly, they are animals of wild nature only; and, according to our present notions at least, they cannot be brought usefully within the pale of domestication; that is to say, we cannot apply their strength, great as it is, to any mechanical purpose; and as they seem to be impatient of restraint, they could not be kept for the sake of their flesh so advantageously as the animals which we at present rear for that purpose, even though a mode of feeding them should be discovered by which their flesh could be rendered as palatable. Fourthly, bears are animals which are equally peculiar in their structure and their habits; and therefore by carefully studying them we put ourselves in possession of many of those general elements which are so serviceable in working out those supplemental parts of natural history upon which direct observation furnishes us with hints, but not with proofs. Their teeth are carnivorous, but only partially so; and their carnivorous structure is more in the canines than in any of the others, so that they are better fitted for wounding and lacerating than for gnawing flesh. The absence of clavicles gives them a wonderful strength in compressing objects between their fore-legs, whether in clasping that on which they climb, or in hugging their enemies. The absence of the same bones admits of much more play in the scapula than in animals which have clavicles; and thus a bear can reach further, and also strike a severer blow than any other animal having equal length and weight of paw. The great size of their plantigrade feet is of great service to them on rough or unstable surfaces. The northern ones walk the surface of the snow with the same ease as people walk when they have snow shoes on. The same form enables them to support their heavy weight upon twigs, or leaves, or grass; so that when they have to range among the bushes or the small trees for berries, and the nests of wild bees and birds, they walk much more lightly and with far less fatigue than one would from the study of their apparently clumsy form be apt to suppose. The same form of the feet, and the fact that the whole length of the tarsi of the hind ones is on the ground, and the first joint above the ground, one with a forward flexure, as in the human knee, gives them not a little of the same stability on the hind feet which man himself possesses;

because, by different bendings of the knee-joint, they can always contrive to make their weight press equally upon the whole sole of the foot from heel to toe. Even the shortness of the tail, or the almost total absence of that organ in some of the species, is convertible into a means of stability, inasmuch as they can bring their buttocks to the ground, and add the support of these to that of the feet, still retaining the uniformity of pressure on the whole soles of the latter. Thus though a bear cannot support the horizontal spine on the hind feet alone, it can stand erect so firmly upon them as to have the most perfect command of its paws, and, with the exception of man, the bears are the only genus of mammalia that can do this, at least to any degree of perfection. There are many other interesting points in their structure, but the above are the leading ones.

BEARDED REED-BIRD (*Calamophilus biarmicus*—Leach); provincial, Reed Pheasant,—Bearded Titmouse. This most elegant and truly beautiful of our indigenous small birds, is an inhabitant of large reedy tracts in various situations both of Europe and Asia, being found in Sweden and other northern countries, and plentifully along the reedy borders of the Caspian Sea; though nowhere in such abundance as in Holland. In this country it inhabits the fenny districts of Norfolk and Cambridgeshire, where it is not uncommon; and is found also in the Essex marshes, and in those of Sussex, bordering on the sea; also in Gloucestershire, Lancashire, and Cornwall. It has likewise been seen near Paisley, in Scotland.

It is a small species; but from the very great length and thickness of its plumage, and the length of its tail and legs, it appears when alive almost as large as a robin. The bill is small and delicate, somewhat of the form of the titmice (*Parus*), but much weaker, and more arcuated, and the upper mandible is slightly curved, and pointed; of a rich yellow colour inclining to orange, but fading almost immediately after death. Irides, fine yellow; in the young of the year, white, with a yellowish tinge. Between the bill and eyes is a tuft of pendent pointed feathers on each side, forming a kind of moustaches; glossy jet black in the male, and of the same colour with the surrounding plumage in the other sex. The head, neck, and breast of the male, of a beautiful pure bluish grey; the latter softly tinted with purplish black; chin and throat very pale ash-grey, almost white; flanks yellowish-brown; the back and tail a very rich yellowish brown, inclining to orange, forming a fine contrast with the grey neck; scapulars wood-brown; greater quills blackish-grey, having their outer webs edged with white; secondaries edged with orange-brown; tail long, and very wedge-shaped, the exterior feathers having their outer webs and tips pale reddish white, under tail-coverts jet black, legs and toes black; in the female, the chin, breast, and sides of the neck, are whitish, with a slight tinge of pink; crown of the head, wood-brown; the occiput sometimes spotted with black; back yellowish brown, in some having a list of blackish spots down the middle; vent, and under tail-coverts, pale yellowish, inclining to wood-brown. The young of the year resemble the adult female, excepting in the colour of the iris, and in having a very broad black line along the back.

This species has been arranged by Linnæus, and by the majority of subsequent writers, with the titmice in the genus *Parus;* and some have even classed it among the shrikes; but the reed-bird differs essentially from both these in several important particulars, though on the whole, perhaps, it more approximates to the former. We have, however, minutely studied it in confinement, and with great attention, when in company with all the English species of Parus, and cannot perceive in it a single character in accordance with the titmice, of sufficient importance to entitle it to range in that genus. It forms one of the numerous connecting links between the small granivorous and insectivorous birds, in many particulars nearly approximating to some of the smaller exotic finches; but we know of no congruous species with which it can be placed, and are inclined to Dr. Leach's opinion, who forms of it a distinct genus, *Calamophilus.*

It differs widely from the titmice in the structure of the digestive organs, the stomach or gizzard being much more muscular than in those birds, and the œsophagus or gullet, containing a considerable enlargement, or crop, as in the finches.

Its manners and habits, also, its whole form, and the nature and disposition of its plumage and colours, all are quite at variance with the titmice: but here it would occupy too much space to enter largely into these particulars. Its mode of progression, when on the ground, is by a peculiar shuffling walk; that of the titmice is by successive hops. It builds itself a regular nest in clumps of reeds or rushes; the genuine *pari* all nidificate in holes. In all the latter the two sexes are much alike; in the reed-bird they are very dissimilar. Their food also, and their haunts, are altogether different.

The reed-bird frequently places one foot upon its food, while it picks it to pieces with its bill, in this somewhat resembling the genuine titmice. But this habit may be observed in various genera, and is even different in the reed-bird from what it is in the *pari;* the latter usually grasp their food (a hemp-seed, for example) with both feet in a peculiar way, and after breaking the husk with quickly-repeated hard knocks of the bill, draw forth and eat the kernel; but the species now under consideration has not the least notion of thus hammering at a seed; nor could it succeed in this, were it even to attempt it, its bill not being formed for such labour; but, in confinement, we have frequently seen it sit by the side of a titmouse that was so employed, and, as soon as the seed was broken, endeavour to make off with the prize. This trick was so often successfully practised by an individual we possessed, that the different titmice which were confined with him became at last extremely shy of attempting to crack a seed when he happened to be near them.

Bearded reed-birds have a remarkable habit of scratching each other's polls in the manner of parrots; and when in the aviary, without a companion of their own species, will frequently go up to other birds, and, presenting the poll to them, seem to implore them to perform the kind office. We have witnessed this repeatedly, and have even seen its desire gratified by birds of very different natures, as the aberdavine (*Carduelis spinus*) and the mountain linnet (*Linaria montana*). Among themselves they are doing this continually.

We have noticed another curious habit in the individuals which have been kept by us in confinement. Among the various seeds which were daily placed in the aviary for the sustenance of their granivorous companions, chanced occasionally to be a small extraneous seed, of which the reed-birds were particularly fond; but as there were never but a very few of these seeds at a time, they had of course some difficulty in finding them from among the rest. The method, therefore, taken to scatter the seed about the cage, to get at the bottom of the pan, was curious, not with the bill, as a finch, or as most other small birds would have done, but by jumping into the pan, and kicking them about in all directions.

The usual call-note of this species is loud and monotonous, and not very unlike the querulous piping of a young chick, that has strayed from the hen; or it may be written thus, *ptear, ptear*, pronounced with some emphasis. When particularly pleased, it utters a low note resembling *pitt, pitt;* and it emits almost continually a low kind of chirp, which also bears some similitude to the faint cry of a newly hatched chick. Besides these, the male sometimes chants forth a variety of hoarse croaking chirps, which may be considered his song; but we have never yet heard the musical note it is alleged to utter among the reeds, resembling *ping, ping-ping-ping-ping*.

Some interesting accounts of the reed-bird in a state of nature, have been published in the magazine of Natural History by Mr. Hoy. "The borders," says he, "of the large pieces of fresh water in Norfolk, called Broads, particularly Hickling and Horsey Broads, are the favourite places of resort of this bird; indeed, it is to be met with in that neighbourhood, whereon there are reeds in any quantity with fenny land adjoining. During the autumn and winter they are found dispersed, generally in small parties, throughout the whole length of the Suffolk coast, wherever there are large tracts of reeds." * * * * "It begins building in the end of April. The nest is composed on the outside with the dead leaves of the reed and sedge, intermixed with a few pieces of grass, and invariably lined with the top of the reed, somewhat in the manner of the nest of the reed-wren" (or reed verderolle, *Salicaria arundinacea*), "but not so compact in the interior. It is generally placed in a tuft of coarse grass or rushes near the ground, or the margin of the dikes, in the fen; also sometimes fixed among the reeds that are broken down, but never suspended between the stems. The eggs vary in number from four to six, rarely seven; pure" (or rather pinkish) "white, sprinkled all over with small purplish red spots, intermixed with a few small faint lines and markings of the same colour; size about the same as those of the ox-eye" (great titmouse), "but much more rounded at the smaller end. Their food during the winter is principally the seed of the reed, and so intent are they in searching for it, that I have taken them with a bird-lime twig attached to the end of a fishing-rod. When alarmed by any sudden noise, or the passing of a hawk, they utter their shrill musical notes, and conceal themselves among the thick bottom of the reeds, but soon resume their station, climbing" (walking up) "the upright stems with the greatest facility. Their manners in feeding approach near to the bottle-tit, often hanging with the head downwards, and turning themselves into the most beautiful attitudes. Their food is not entirely the reed-seeds, but insects and their larvæ, and the very young shell snails, which are numerous at the bottom of the reedlings." One we lately examined, which had evidently escaped from confinement, and which was knocked down with a stone, contained in its stomach the remains of flies. We have seen them eat small shell snails, in confinement. Mr. Hoy continues, "I have been enabled to watch their motions when in search of insects, having when there has been a little wind stirring, been often within a few feet of them quite unnoticed among the reeds. Were it not for their note betraying them, they would be but seldom seen." * * * * "The males and females I have always observed in company; they appear to keep in families until the pairing time, in the manner of the bottle-tit; differing in this respect, that you will occasionally find them congregated in large flocks more particularly during the month of October, when they are migrating from their breeding place."

Another correspondent of the Magazine of Natural History observes:—"The bearded titmouse" (reed-bird) "inhabits the marshes bordering on the Thames, both in Kent and Essex. I was told in December last that some had been seen in a large piece of reeds below Barking Creek; and being desirous of observing them in their haunts, I went out, accompanied by one person and a dog, to the above-named place, on a cold windy morning; the reed-cutters having commenced their operations, I was fearful of deferring my visit, lest my game might be driven away. Arrived on our ground, we traversed it some time without success, and were about to leave it, when our attention was aroused by the alarm-cry of this bird. Looking up, we saw eight or ten of these beautiful creatures on the wing, just topping the reeds over our heads, uttering in full chorus their forcibly musical note, which resembles the monosyllable *ping, ping*, pronounced at first slow and single, then two or three times in a more hurried manner, uttered in a clear and ringing, though soft tone, which well corresponds with the beauty and delicacy of this bird. Their flights were short and low, only sufficient to clear the reeds, on the seedy tops of which they alight to feed, hanging, like most of their tribe," (that is, like the various titmice) "with the head or back downwards. If disturbed, they descend by running, or rather by dropping. The movement is rapid along the stalk to the bottom, where they creep and flit, perfectly concealed by the closeness of the covert, which resembles the tint of their plumage. After some time we were fortunate enough to shoot one, a male in fine plumage. I held it in my hand when scarcely dead. Nothing could exceed the beauty of the eye; the bright orange of the iris, surrounded by the deep glossy black of the moustaches and streak above, receives additional brilliancy from the contrast, and struck me as a masterpiece of colour and neatness."

Fine specimens of this beautiful bird may often be procured in the London markets during the winter months; these are brought from the Essex marshes. In summer they are less valuable as specimens, as the tail feathers and other parts of the plumage are often injured, and sometimes soiled with dirt. Great numbers of them, also, are annually brought to London alive, about the fall of the year, from Holland, and may be purchased of the dealers for a trifle. They are tolerably hardy, but exceedingly subject to fits of apoplexy, if fed upon too nutritious food: we have seen them fall from their perch three or four times in the course of the day, and such as do so rarely survive many weeks. They are usually, however, stout and healthy birds, if not suffered to get too fat; and very ornamental in the aviary, though it would not be advisable to procure more than a single pair, on account of their being so garrulous and noisy.

Male Bearded Tit, or Reed Bird.

We hardly remember having noticed any bird so remarkably fond of society as this species. A fine male, which we long kept in confinement, in a large cage, together with a variety of other small birds, generally passed his time on the higher perches, where, if left alone by the others even for a moment, he raised a most pitiful outcry, endeavouring by every means in his power to call them up; and then sometimes, when all his efforts were unavailing, and he could brook solitude no longer, he would descend, and strut among his companions, chuckling with pleasure at being again in their society. He was most unceasingly active, insomuch that it was often difficult to obtain even a momentary view of his lovely plumage; and his movements were at all times remarkably light and graceful, bearing a curious resemblance to those of the monkeys in the large cage in the Zoological Gardens; a resemblance not altogether fanciful, for it was remarked by several persons. Like the monkeys, he often hung by one leg from the top of the cage, and looked around him: but perhaps some of these traits were chiefly owing to the large size and convenient form of the cage which he inhabited; for in describing the habits of birds in confinement it is always necessary to have an eye to such circumstances, their habits being often affected by the peculiar size or form of the cage in which they may chance to be confined, as we might illustrate by numerous examples.

The bearded reed-bird is of a very timorous nature, and is often a very long time before it becomes sufficiently familiar to feed when a person is looking at it. Some pains were taken to tame the individual above-mentioned, and he would take bread and milk from the hand, but not without the greatest circumspection, and the most extreme readiness to retreat at the least move of the person who offered it. He was immoderately fond of this food, but it did not agree with him, as he was always ill after eating it in any quantity. His extreme timidity was also shown when disturbed from his roost at night, being alarmed at the slightest noise, and flying about with his long pheasant-like tail expanded wide, which made him look even handsomer than usual.

The legs and feet of this species are large and strong, and would appear disproportionate, were it not for the plumage being so exceedingly thick and puffy; the claws are long and pointed, very unlike those of the different titmice, but resembling those of the American rice-bird (*Dolychonix orizivora*), and other species which pass their time on the perpendicular stems of reeds and rice plants.

BEAVER (*Castor fiber*). A genus of mammalia belonging to the order *Rodentia* or gnawers. It consists of only one species, and that species is peculiar in its locality, being found only in the colder parts of the temperate latitudes in the northern hemisphere, and there only in wild places, by the banks of pools, lakes, and streams, which lie in the fastnesses of the forests, or otherwise secluded in their character, and distant from the abodes of civilised man.

But though there is, in this genus, no variety of species, and not very much diversity of haunt to be described, it is still an exceedingly interesting animal, and one of which perhaps more marvellous stories have been told and printed than of any other. It would be foreign to our purpose to repeat those stories even for the sake of refuting them; and we shall therefore take the shorter method of pointing out what the animal is like, where it inhabits, what it is capable of doing, how it is captured, and to what uses it is applied, adding, as the occasion may suggest, a few words on its general relations to the rest of nature.

The beaver is so decidedly a gnawing animal in the structure of its teeth, that it may without impropriety be considered as the most perfectly typical one in the order to which it belongs. Its cutting teeth are two in each jaw; very large and strong; and standing so far clear of the lips, that the animal can easily gnaw or cut a hard substance without the least danger of injury to these. The structure of these teeth, though common to most of the order, is peculiar and well worthy of notice. On their front sides these teeth are broad and flat, not white like the teeth of most animals, but of a brownish yellow, or a chestnut colour. They have along the front surfaces, a plate of very hard enamel, which covers the bone or principal substance of the tooth, just as a piece of steel may be seen covering the iron on the cutting edge of a chisel, which is both sharp and not liable to be broken. The body of the tooth is compact, but not very hard bone; and it is strengthened by a projecting ridge on the posterior surface, in the same manner as hoes and various other tools are fortified, by a ridge extending from the socket which receives the handle. The tooth is thus formed upon the most skilful mechanical principles, both in the distribution of the materials and in the form. Bone, though not so hard a substance as enamel, is tougher, just as iron is tougher than hardened steel. The softness makes it wear faster than the enamel, and the toughness makes the tooth less easily broken. If the whole tooth had been enamel, it would have in time got blunted, by the cutting edge wearing down faster than the rest; but the bone wears with less action than the enamel; and thus the enamel always stands highest, and forms a cutting edge, while the bone supports it behind like the basil or sloping edge of a tool. Thus the cutting tooth of the beaver is a chisel, and whether the carpenter's chisel has been made in imitation of it or not, the same arrange- of iron and steel as there is of bone and enamel in the tooth, is the best possible for a chisel of all work. There is one property in the chisel of the beaver, however, which no art of man can give to the chisel of the carpenter; the incisive or chisel teeth in the beaver have not roots consisting wholly of bone, as in the teeth of most animals, and as in the grinders of the beaver itself. They are inserted deeply in the jaws; but they are inserted in a peculiar kind of socket—a socket which exists only during dentition in other teeth. These sockets continue gradually to produce the tooth in such a manner as that both bone and enamel grow at the root as fast as they are worn down at the point; and consequently those chisel teeth remain in good condition during the whole life of the animal. Their chisel edges are directly opposed to each other, so that when the animal bites, it bites clean, just in the same manner as a workman cuts a wire or other small piece of metal, with his cutting pincers. If by any means a beaver loses one of those teeth, the opposite one in the other jaw, having nothing to act against, is not worn down, but continues growing till the point of it projects beyond the mouth, and the animal bites less effectively than if that one had been removed as well as its opponent.

As is the case in all the rodentia, beavers have no canine teeth. Such teeth would not only, from the nature of their food, be perfectly useless to them, but would be in the way of the cutting teeth, and prevent them from acting properly. The grinders are four in each side of both jaws, flat on the crowns, and adapted for masticating vegetable substances. They are, indeed, better adapted for this purpose than the grinders of most of even this order, being marked with projecting ridges of enamel, which can divide substances of almost ligneous texture. Of these ridges or folds, there are four on the crown of each tooth; but they are differently arranged in the two jaws. Those of the upper jaw have three folds on their outer surfaces and one on their inner, and those in the lower jaw have one on the outer, and three on the inner; by this means the bark and other dry and rigid vegetable substances which the animal masticates preparatory for the stomach, are broken at the middle of the tooth, and reduced to smaller portions at each edge. The jaws have no lateral motion upon each other; so that the action of the cheek teeth upon the food, more resembles that of a bark-mill than the ordinary grinding motion in ruminant animals. These cheek or grinding teeth have proper roots, and not the same kind of socket as the front teeth, so that they do not increase by growth at the roots, as they wear down by using at the crowns.

In the different modes of structure and growth of the two sets of teeth in these animals, we have a striking instance of the economy which is displayed in the structural adaptations of nature. The cutting teeth have not only the severest labour to perform in the finding of the food; they have various other functions: they cut the wood, the bark of which is to be the winter store, and also that which is to be used in the construction of the dam or the hut; and, in the performance of these operations, they have a harder task than the teeth of most animals. The cheek teeth though they have to grind harder food than those of most of the mammalia, have slight labour as compared with the cutting teeth; and thus, while the latter are in constant growth, the former attain their full size in the usual manner, and afterwards grow no more. Thus, in the beaver, where the extraordinary work has to be performed, we have the extraordinary instrument for the performance of it, and in that part where there is no extraordinary work, the instrument follows the ordinary law; only the structure of the coronal surfaces of the grinding teeth, is, as has been said, adapted for dividing substances approaching to the nature of wood, rather than succulent or soft vegetable matters.

And this is a general law in nature, and one which most clearly establishes not only a purpose, and by consequence a Maker, in all that nature displays; but it shows that, anterior to creation itself, that Maker must have known intimately, in itself and in its connexion, every property of every substance, every law of every combination, and every principle of every science, mechanical, chemical, or whatever else. Nay more, that the properties, the laws and the principles must have emanated from that Maker, and from Him alone; and that all which the most learned and the most studious of the human race can know of any of those subjects, or of any part of them, is not originally of human invention or human skill; but the humble and simple discovery of that which God has ordained, and bearing probably no more proportion to the knowable part of the whole than a single dew drop of the grass bears to the congregated waters of the Ocean. Then, though we could carry our knowledge to the full measure of this science—the science which being perceived by material organs of sense, must be in itself material, there remains behind a portion of the system far mightier in its extent, and more wonderful in its operation—the law of life—that mighty mandate which is one and continuous, yet varied as the races of being, and the ages at which they live—nay, as the individuals of those races, and as those small moments of their existence, which no sense or instrument can measure.

To this portion of the subject, into which it is not given to mortal eyes to look, the mind can contemplate only an infinitude in every part, or so to express that to which no tongue of man is equal, an infinitude of infinitudes in the whole; a reflected but express image of the Omniscient and Almighty Maker and Governor.

Nor, when we come even to the details, do we fail to find proofs of this. Every power of life, considered in itself, and without reference to the quantity of material substance on which it acts, is, to our comprehension, infinite in its power; and, as we have had occasion to state again and again in the course of this work, there is not a living energy recorded within the whole volume of nature's book but which, if it had full scope for its working, would in brief space replenish the earth with its own species; and it would be easy to demonstrate, upon principles the best known and the least liable to mistake or fallacy, that in some species (as, for instance, in the common cod-fish) this energy, originating in a single pair, could turn, in half the average period of human life, as much matter as there is in the sun and all the planets into that species of fish.

Thus on this part of the subject there is no need for economy, or saving in any sense of the term. That which the line cannot measure, and the balance cannot weigh, cannot be meted off by the line or weighed off by the balance, so as to diminish its quantity by any nameable fraction of a hairbreadth or a grain. When it works it is never weary; when it gives even to the excess of its bounty, it is never one tittle the less. It stands invisible to every material sense, unless when displayed in material substance; but it stands to our mental view as immeasurable and immortal; and though obscured as our mental contemplation is by the material body, we cannot *now* know and behold it in its essence, yet we dare not say, even if we take the remotest points in time or in space which arithmetic can express or imagination picture, "here it begins, or here it ends."

But wherever matter is the element, be the application of that element what it may, we find the most perfect economy exhibited throughout the whole system; and that whether in what we call mechanical structure, or chemical combination, or the action of either or both. In machines which are made by mechanics, those are reckoned the most perfect which are the least loaded with unnecessary parts, or unnecessary weight. From the limited extent of our knowledge, we make but very loose approximations in this way; and as one part moves fast and another slow, one is exposed to variable and one to uniform temperature, and so forth; we are unable to adapt the form and the quantity of our materials to these, and therefore the works of our most skilful artists wear out much more in consequence of not being made on true principles, than of what may be termed fair wear.

In nature it is not so; for taking the average of nature's productions and of the functions which the parts of them are called upon to perform, there is not a single grain either redundant, defective, or one hairbreadth out of its place. It is this which makes the study of animal mechanics so instructive and so useful in every art, and therefore to every man; though (as has been too often the case in our views of nature) we have done as the ignorant man did with the spy-glass, looked in at the wrong end, and thereby driven away and diminished that which the skilful use of the instrument would have brought nearer and magnified. We have carried the principles and even the applications of human mechanics, as the models in our judgments of nature; and as these are all imperfect and really imitations (though frequently unknown imitations) of nature, we have gone about as though we had been to teach nature instead of learning of her.

The structure of the beavers' teeth gives us, as we have already seen, the models of some of our mechanical instruments in their best forms, though with us they are made of different materials; and as the beaver is, even discounting all the exaggerations which have been related of him, the most mechanical of all the mammalia, we have thought that it would be at once more useful, and savour less of the mere parade of science, to introduce these general observations in our account of the beaver, than in any article more expressly on the subject of animal mechanics, and of the limit beyond which we must not carry our mechanical theory when treating of the structure and economy of animals as they appear to us in wild nature. Having done so, we return to our structural account of the beaver.

We have already described the teeth; but we must mention several of the other parts before we be in a condition for understanding the habits of the animal; for, as there is but one species of beaver, and as that species is the same, and inhabits the same kind of localities in all countries in which it is found, it is one of the very best species from the study of which to see clearly the natural connection which subsists between structure and locality. The relation between these, once clearly seen, and well understood in one instance, can with much safety be carried to other instances, and forms at once one of the securest and the most instructive of analogies.

The beaver is low and squat in its body; the line of its profile from the occiput to the muzzle is unbroken; the muzzle is oblique and blunt; and the upper lip cleft, as in the hare. The eyes are small, oblique, and wide apart from each other; and the ears also are small. The fur is remarkably close and soft; but interspersed with longer bristly hairs, which get more abundant as the animal grows older; both the hind and the fore legs seem short in proportion to the size of the animal when it walks on the ground; but, as is the case with all animals of the order, the habit of which is generally to leap, to stand up, or to support themselves on their hind legs, these are much longer than the fore ones. They are, however, differently articulated, especially at the knee joints, which turn inwards, as in a man who is what is called "knock-kneed," and thus the hind feet are shambling and wide apart from each other in walking, though in their other function of swimming they answer better in consequence of this mode of articulation. Swimming feet, and especially the hind feet of swimming mammalia, are always constructed in this manner, except in those species in which (as in the seal, for instance) they are formed into a swimming sail, and in consequence of this they act more horizontally, and consequently impel the animal forward in the water with more velocity by less exertion. Animals which are constructed principally for walking on the land, make the chief exertion with the fore feet when they swim; and therefore they are sooner fatigued than when they move even faster upon land; but quadruped animals having a regular swimming habit, impel themselves chiefly by means of the hind feet, and on this account they are no more fatigued in the water than they are on land. The reason of this will be readily understood by those who are aware how much more easily a boat is pulled by oars nearly on a level with the water, and near the quarters, than by oars which have to dip much downwards and are used near the bows.

The beaver has this swimming property of the hind feet in greater perfection than almost any other quadruped; because when making way by means of these, it often has occasion to use the fore feet for purposes not connected with swimming, such as in assisting in moving along billets of wood, stones, or such other matters as the animal requires for its food or its buildings. These feet in the beaver are in consequence rather more awkward upon land than any other feet of the same length and muscular power; but, generally speaking, it is in the water that the beaver performs the more arduous portion of its labours, and the instruments of motion in that element are best adapted for it. There are five toes on each of those hind feet, which are free in the joints of all the phalanges of the bones; so that they can come close together when the animal walks on land, and spread wide of each other when it swims in water. They are all united up to the claws by strong but soft and flexible membrane, so that the feet form very effective paddles, and they can be spread to their full extent for the stroke, and closed while they are recovering, which answers the same purpose as "feathering" an oar, only it answers that purpose much better. The nails upon the toes of these feet are thick and strong; and the second one is a sort of double, by having a supplemental part in the form of a sharp ridge on the under side, the use of which is not very well known; though it may answer some purpose in scraping or otherwise dividing substances.

The fore feet are not so strong as the hind ones; the joints of them are articulated more in the common manner of those of walking animals. The toes on them are completely divided, and admit of so much motion in their phalanges that they act something like thumbless hands, in which the point of resistance to all the five toes is the wrist; but hands or paws of this description are best adapted for acting against each other, or in concert with the mouth, as is very much the habit with the beaver either when moving substances on land when it is not walking, or for moving substances through the water.

In the use of its feet in walking the beaver combines two distinct habits. On the fore feet it is *digitigrade*, or walks on the toes only; and on the hind feet it is *plantigrade*, or walks on the entire length of the sole. This, again, gives the fore feet more apparent stability than the hind ones in walking, but it gives the whole animal a wriggling gait, and it is in consequence rather a slow animal upon land.

The tail of the beaver is the most peculiar part of its structure. It is very large, nearly half as long as the body of the animal, oval in shape, and flattened on the upper and under sides. It is also, with the exception of a small portion at its base (which is very thick and strong), covered not with fur, like the rest of the animal, but with a sort of horny scales, which are produced by a thick and dark coloured skin. The singular structure of this organ, and the remarkable difference between its covering and that of the rest of the body, has furnished a theme of much exaggeration with those who have *imagined* the habits of the beaver from the structure of the dead animal, and that apparently with marvellously little either of anatomical or of mechanical knowledge to guide them to any thing like rational, or even possible conclusions. It has been described as a mattock for digging pits, a ram for driving stakes, a trowel for smoothing plaster, and many other unbeaver-like operations; and as the arrangement of the scales is not very unlike the toothing of a file, it is somewhat astonishing that they did not add the function of that instrument also in smoothing and polishing the ornamental wood-work of its dwelling! But the plain fact is, that there is not one word of truth in any of these statements; and no one who had ever seen a living beaver, or examined a dead one, with even a very moderate degree of the requisite knowledge, would have been guilty of any thing so totally inconsistent both with the habits of the animal and the structure of the organ. The tail of the beaver is not even very efficiently a swimming tail, but rather a rudder for the directing of the animal's aquatic course. It has very little vertical motion, being capable of just rising above the straight line, having remarkably little flexure in that way in its length, and generally being partially in contact with the ground when the animal walks. Its lateral motion is also by no means great; and from that, as well as from its shape, it cannot be very effective in impelling the animal through the water, though the resistance of the scales may prevent a recoil from the stroke of the swimming feet; and the steadiness of the tail—its very inaptitude for the purposes to which authors have applied it, fits it the better for answering this purpose. There is also another use of the tail, and this, too, depends in no small degree upon its stiffness: it is sometimes used as a means of support. The loose articulation of the knee joints, and the tendency which these give the feet to separate, render them alone a very unstable base when the animal stands up, as it often has occasion to do in the procuring of its food and materials, and also in the constructing of its dams and dwellings. In these operations it very often requires to have both mouth and fore paws at perfect command, without much reference to the balancing of its body; and as the stiff tail converts it for the time into a sort of tripod, it is in that way very serviceable. We may therefore thus briefly sum up the functions of the working organs in the beaver: the fore teeth are cutting pincers, or double chisels, so that they act against each other, and their action is so powerful, that they will cut a moderately thick twig as clean across as if it were done with a knife. The grinders are adapted for bruising bark; the fore paws are the most efficient working instruments, and also in some degree hands; the hind feet are most effective as swimming paddles; and the tail is a rudder in the water, and occasionally a supporting prop, when the position of the animal requires one. From this general description of the structure, the functions of the parts may in a great measure be inferred.

Beavers are found in most of the northern latitudes of both continents, in places which are adapted to their habits, that is, in places which are remote from the dwellings of man, and abound in wood and water. They were not unknown in the British islands; for though we cannot implicitly credit all the accounts of them in the living state, and certainly not those which mention their existence as recently as the fifteenth century, yet we cannot disbelieve all the older accounts, supported as these are by the unequivocal proof of the bones of the animals found embedded in the soil. Such remains are not very numerous, or generally distributed; but they have been found in Berkshire in marl under peat.

This carries us back to a very remote period, and one in which the state of the country must have been very different from what it is at present. We are not aware of any situation in which a deposit of marl can form other than in stagnant water, and then either by calcareous oozings out of the earth, or by the deposit of the shells of fresh water mollusca, carried on through a long period of time; for when peat forms upon a bottom which is not covered with water, the substratum under it is not marl, but sand, gravel, or clay. If we look at the description of places which beavers now inhabit, we shall be enabled to form some idea of what must have been the state of our own country during the era of the beaver—forests of deciduous trees, for the beaver is not so fond of the bark of pines, with numerous streams, pools, and lakes; long winters, with heavy falls of snow, and probably continued drought in the summer, because there is much less atmospheric action between the sea and the land in a wood-clad and humid country than in one which is cleared of its forests and drained.

At present, though there are some beavers in the west of Europe, as far to the south as Germany, they may be said to be few and scattered in that part of the world, and not very numerous in the north of Asia. Their head-quarters are in North America, though even there they are fading fast before the invading foot of human settlement, and the unceasing labours of the hunters. There are still, however, immense tracts of that country remarkably well adapted to their habits, and there they are proportionally abundant.

Some slight differences have been found (or fancied) between the skulls of the few beavers of the two continents which have been examined, but certainly not greater than those which may be observed between the skulls of human beings of the same nation, or even of the same family. It has also been said that their habits in the two continents differ from each other; but the difference is not greater than between the beavers in different parts of the same continent. Thus there is no reason to conclude that there are even two varieties of beavers, far less that there are two species.

From what has been said of the structure of these animals, it will be seen that they have a double element, being adapted both for the land and the water, and perhaps for both in nearly an equal degree; for though the hind feet are aquatic rather than terrestrial in their structure, the structure of the fore ones is wholly terrestrial, and the animal is in no respect a water-feeder. It spends, indeed, a considerable portion of its time on the margin of the waters, and some part of it in that fluid, but the water directly produces nothing which can be considered as beaver's food. The beaver eats no animal substance; and plants which are strictly aquatic, and grow in the water without being rooted in the soil, have no matter in them adapted for its support. Sometimes, indeed, beavers eat the roots of water lilies, and other plants which form bulbs or other roots, containing, during the season of their repose, a considerable quantity of albuminous matter; but these are not, strictly speaking, water plants; they are marsh plants, and though water is necessary to their growth, soil is equally so, as we never find them on the washed sands or clean gravel of running streams.

But as the beaver has thus a double element, it has a double habit, answering to different seasons of the year; and though it never inhabits so far landward as that the water is out of its reach as a means of escape from land enemies, and might be said never absolutely to inhabit the water at all, it is almost exclusively a land animal (except for safety) in the summer, and much more towards the water in the winter. This double habit is carried on with some difference, at least in the winter portion of it, according to the locality; but still it shows us the use of the beaver in wild nature, and that brings us back again to the peculiar state of countries in which beavers inhabit them. Deciduous shrubs and trees, which of course grow most abundantly and luxuriantly in humid, but not, generally speaking, in marshy places, are the characteristic vegetation there, and would in time overcome and destroy all else, and finish the scene with self-destruction, if their exuberance were not by some means or other restrained.

To restrain this exuberance is the peculiar province of the beaver, in like manner as it appears to be one of the natural uses of the hare to restrain the over-abundance of forest trees on dry grounds, by barking the seedlings in the winter, so that they perish. Accordingly, while those trees and bushes which the beaver has more immediately in charge are in a state of growth, the beaver ranges about among them, eating the young shoots, the young seedlings, and also the berries, in their season. But when the trees become leafless the animal instinctively lops the twigs, even those of considerable size; then cuts them in lengths, so that it can remove them; and carries them to the water, where they remain in little floats, secured in proper places against being swept away by the floods, and removed thence to the winter dwelling of the animal, as occasion requires. Sometimes, also, it stores up twigs in the winter habitation; and it does so the more decidedly the deeper that the water on the margin of which that habitation is situated is liable to be frozen.

In summer, beavers, as is the case with many animals which are social in winter, disperse themselves through the groves and brakes on the banks, and lead solitary lives, reposing for the night or the day, as it happens (for they are equally fitted for work during the one as the other), in the shelter of whatever bush or hole close by the water may be most convenient to them. During the time which they so inhabit they are not very much molested by the hunters, at least by those hunters who kill them solely or chiefly for the sake of their skins; because then, as is the case with all animals of countries having hot summers and severe winters, their fur is neither so abundant nor so valuable as during the cold season. In the early part of the summer the old fur is dead and loose, and the new is only partially grown; whereas against the time that the coldest winter weather comes round, all the fur which is on the animal is alive, and in the greatest abundance and ripeness. There are other reasons in favour of the winter capture: in summer there is an effort for each solitary individual, whereas in winter those which associate may be taken *en masse* by means of nets and other devices. In summer, too, the flesh of these animals is not quite so good as in winter, or at least as at the commencement of the latter season: and hence the winter is the grand time for the capture of them for food as well as for clothing, or for materials of which articles of clothing may be manufactured.

During the summer season the habits of all beavers are as nearly the same as the nature of the places in which they reside will admit; and the chief differences are more or less labour in the finding of their food, in proportion as that food is less or more scattered over the surface. With equal temperature, those places which are the most humid, and on which the water remains the longest, without stagnating, so as to prevent the growth of shrubs and trees, are the best adapted for the support of beavers during the summer. The decline of the surface of much of Europe and Asia, in this respect, is one of the causes of the diminished and diminishing number of beavers there; and the same may be said of those parts of America in which they are few and scattered, and have the same habits as in Europe.

The winter habit varies more than the summer one. It is not ascertained, and indeed not very probable, that beavers hybernate under any circumstances of climate or season; but as they are much more active during summer than during winter, it is probable that they eat much less during the latter period. Indeed it has been found that beavers which have been kept in a state of solitary confinement from early youth, and have not required to exert themselves either in the finding of food, or in the constructing of winter habitations, have spent a very considerable portion of time in a dormant, or, at all events, in an indolent state. Others, taken later in life, have shown more activity, and have displayed more of a peculiar instinct in their nature, as will appear from a notice of one which we shall quote in the sequel.

But whatever may be their habits in a state of confinement—and their habits there, or at all events their propensities, are not solitary, inasmuch as they evince an attachment to those who are kind to them—they all, in a state of nature, make some preparations for the approach of winter, and the nature of those preparations seems in a great measure to depend on the numbers which are in the vicinity of each other during the summer. If scattered far apart they must be as solitary during one season as another; but when they are near each other they can associate. In the former circumstances they burrow for their winter habitations; and in the latter they partly excavate the ground, and partly build. Their fore-paws are well constructed for the first of these operations, and they are by no means unserviceable in the latter.

The burrow of the beaver, even when formed for a single pair or a solitary animal, has usually two openings—one under the surface of the water, by which the animal can escape into that fluid for protection, or fetch provisions from it, as occasion may require; and a smaller one towards the land, through which atmospheric air may come for the supply of the animal in breathing. Other than these two apertures, and some other animals have more than two, there is no indication of superior ingenuity about the burrow of the beaver. It is, indeed, much inferior to that of the common mole, and those of many other animals.

Though the beaver thus constructs its burrow on the bank, with an opening under water, water is not absolutely necessary to its existence, or even to its health. It is altogether a land animal in its breathing and circulation; and while it is active these go on with moderate rapidity, though not so quick as in many of the mammalia. Such being the nature of its vital system, it is unable to remain under water for any great length of time. Both the nostrils and the ears are so constructed as to close and exclude the water when the head of the animal is immersed; but as the beaver only occasionally works with the head under water, and does not require to feed with it in that state, it cannot remain nearly so long without coming up to breathe as the seal, which is a fisher, and as such dependent on the water for its food. The eyes of the beaver, of course, require no protection from the water when it has occasion to use them under the surface, because the eye of no animal is injured by simple contact with water. Persons who accustom themselves so far to it as to be able to get the better of the shock, which takes place upon immersion, can see quite well in the water when they dive.

From what appears to be the principal use of water to the beavers, we can form some estimate of the contrivances to which they resort for keeping it at the same level in places where they live in societies. The nature of the places is such that the animals cannot range for their food in winter as they do in summer. The trees are leafless, the ground is covered with snow, and those twigs which they can reach with ease in summer are buried under it. They must therefore collect a store: that store must be proportional to the numbers; and if these are considerable, it must be fetched from some distance, and the greater, the longer they have resided in the same neighbourhood. The reason of this last fact will become apparent when it is considered that the winter food of the beaver must be the bark of twigs of more than one year's growth. They are not climbers, and then they cannot reach any higher than when they stand on the hind legs supported by the tail, in the tripod fashion which has been mentioned. A number of them would soon clear the bushes and trees to their height over a considerable space, though each season might throw out shoots, sufficient for their food in summer when they live dispersedly. Besides, those deciduous trees, or bushes with branches within the beaver's reach, do not grow over the breadth of the forest in any latitude, and especially not in those latitudes which beavers inhabit. On the dry "barrens," and also on the swamps, there are pines and other evergreen coniferæ; and where these are tall and close, as they always are in comparatively rich places of the kinds which suit them, there are no deciduous shrubs under them. Mosses, lichens, and fungi, are then the under growth, and they are not beaver's food, neither are they accessible after the snow has fallen. The stores for the food, and especially for the winter food of the beavers, is thus found in lines along the margins of the waters; and they must range these for a considerable length before they can find food for a colony.

Beavers are but lame walkers for long distances, and they are of course still more incapable of carrying burdens very far. One of the stories, indeed, is that they use the tail as a sledge; but that, if one of them can be more absurd than another, is the most absurd of the whole. None of the land mammalia can bear much strain on the tail, and the tail of the beaver appears to be quite burden enough to the parts which support it when the animal walks on land. Of course the possibility of its carrying a load upon that organ is entirely out of the question.

Its ordinary means of carrying, when the object is not too large for being so carried, is by the mouth. The billet which can be carried in this way for any distance must be short and light, otherwise it would constantly be getting entangled in the bushes, and the animal could not fetch it along. Even when the billet is larger, the mouth must still be the holding instrument, and one of the points of support in the carrying; because the animal could not walk at all if it held with its paws. The shoulder is the part brought in to assist in these cases; but as the billet is inflexible, and cannot be carried as a fox carries a goose, it lies obliquely on the shoulder, and of course is a cumbrous load, and incapable of being carried very far.

To obviate the difficulties of this process, the beaver has recourse to water carriage, in the same way that man has recourse to water carriage when he goes "lumbering," that is, procuring timber in the wild forest. This is not the case with man in the north of America only, but in all parts of the world; and thus far *reason*, which proceeds on the principle of cause and effect, and *instinct*, which proceeds from a cause which we are unable to comprehend, but which certainly has nothing to do with experience, without which there can be no reason or forethought plan, produces the same end by very nearly, if not exactly, the same means.

And when we come to the mechanical operation, we can see that this must be the case. Neither instinct nor reason can alter the properties of that matter on which it acts, whether it be the substance of which its own members are made, or any foreign substance. If the billet or the log is heavier than the strength can move at all, or over the requisite distance, and the purpose either of instinct or of reason is to remove it entire, neither beaver nor man can bring the strength up to the weight, or the weight down to the strength, as both of these fall within the province only of that power, which made the animal structure and the piece of timber. But in the water, the weight of ordinary timber—of all which grows where beavers inhabit, is wholly destroyed as a pressure on the animal, and there is only the resistance of the water's friction to be overcome.

It is this use of the water which sends the beaver into that element, just as it is the production of his food there which sends him to inhabit the banks; or to speak more correctly, the bank; the beaver and all the circumstances of nature in the locality harmonise with each other. Destroy the harmony, and the animal being the most sensitive of the whole, is the first to disappear,—though when the combination is broken up, all the others depart, in the ratio of their changeableness; and the place assumes, to all appearance, a new character. Thus, in those places of Berkshire where the skeletons of beavers are found in the marl under the peat, the probability is that there once had been standing pools with thickets of deciduous trees on their margins, and banks in which the beavers could dig their burrows or construct their huts, according as they were less or more numerous. To this stage had followed another of green mosses, first in the stagnant pool, become shallow by deposits, but increasing at the top and dying at the roots, as mosses are known to do under such circumstances, until what was once a hollow changed to a level surface or even to a height, and till that height consumed the surrounding thickets and groves, and then, exposed to the frost in winter and the drought in summer, become black and sterile, save here and there a few stunted heaths, and other small plants of the desert. There may have been and in many places there are evidences of changes subsequent to these, in which the powers of life have been brought again into action, in a manner altogether different. Deposits of gravel intermixed with fine particles and finished off with vegetable mould, now lie over many such anterior formations as those alluded to, and by the aid of culture are among the most fertile spots in the island. Thus we see that the beaver, as belonging to what we may consider an early stage in the progressive natural history of countries, has a long and a highly interesting story to tell; and one which, duly studied and applied, might be of vast service to us in that artificial cultivation and fertility, upon which we so primarily depend for our food, our clothing, and very many of the other comforts of life.

Beavers have wholly disappeared from those parts of North America which are settled and cultivated; and upon the frontier, where wild nature and man's cultivation may be said to divide the management between them, they are few, straggling, and solitary, and invariably spend the winter in burrows. The burrow of a solitary beaver is seldom, if ever, accompanied by a dam for the regulation of the waters; and where there are villages or colonies, the dam is used only in those situations where, during the sojourn of the animals in their winter's abode, the water is liable to great differences of level. This depends both upon the nature of the water, and the character of the seasons. It is less in pools and lakes than in rivers; and less where the winter is open, and the spring gradual, than where the snow lies long and the thaw is rapid and violent. The latter circumstances prevail in a much higher degree in those parts of America which are still well stocked with beavers, than in any part of Europe, or perhaps of Asia. The autumnal rains are not so heavy there, and do not swell the water so much as they do in milder and more variable climates. The humidity falls much in snow; and the floods occur when that snow melts upon the return of warm weather. Thus, unless to secure a depth which shall not be frozen to the bottom, or one which otherwise shall conduce to floatage and swimming in the winter, beavers have no great occasion for dams, on the larger and more slowly-flowing rivers in that part of the world. The smaller creeks, however, are in some situations apt to be very low, and indeed almost dry in the autumn, the time when the beavers require water the most, because that is the time at which they float along their provisions and other materials.

These latter situations give occasion for many beavers' dams; and though the accounts of the manner of constructing these and their neatness when constructed, have been as much exaggerated as any part in the economy of the animals, yet they are curious structures. The instinct according to which they are made, both as regards the original necessity for them, and their form, is of course as inscrutable by human philosophy as any other instinct. But still the structures themselves are formed upon what we may call sound mechanical principles. The beavers do not, as authors say, fell a large tree so that it may fall across the river and form a head beam for the dam; and as little do they drive perpendicular stakes, or stakes slightly inclined, so as to bear against the beam. They do not fell great trees at all, neither do they set any timbers on end, or arrange them in what we would consider a symmetrical manner. They do indeed make use of billets of wood much thicker than they can cut at one bite—the maximum of which is only about that of an ordinary walking stick. When they cut these larger pieces, they cut them round the circumference, as wood-men do in the operation which in America is termed "girdling," and after once round, they cut round again and again, until a division is effected.

The construction, and also the necessary repair of their dams, usually takes place during the night; so that the precise manner of their working is guessed at rather than known; but the billets of wood are laid across each other, and kept down by means of stones; and the interstices are filled with mud and clay, until the whole dam is rendered water-tight. In the performing of all these labours, they have no instruments that will come into use except the fore-paws and the teeth; but these, from the description which has been given, are well adapted for the purposes.

The timber which they use in the construction of both their houses and dams, is very generally drift wood, of which large quantities are always to be met with in the rivers of these wild countries. This of course requires no felling; and when they find it in the water they can contrive to tow along a large piece; but if it is on the dry bank at some distance, they must cut in lengths, and bear it on their shoulders in the manner which has been already stated. When they have to fell their own timber, they usually have recourse to soft wood, as willow, poplar, and birch; and they rarely cut any piece even of the drift wood, of more than two or three inches in diameter. Small sizes are indeed preferred; and here again their instinct is true to mechanical principle, because the working is lighter and the work itself is more compact. The dam is formed with a broad base and a slope both ways, till it is considerably narrower at top; but however much the level of the bottom may vary, that of the top is made the same all the way; and while, by means of their dam, the colony of beavers will sometimes obtain a depth of several feet of water, the current over the top of the dam will be so spread in breadth, that a man may cross without very much wetting his feet.

It is said that the position of the dam is tempered to the velocity of the current; and this is certainly no more wonderful than the fact of a dam being made. If the current is slow, the dam is said to be carried straight across; but if it is rapid, the dam is an oblique line, or a curve with its convexity upward to the stream. This again is true to the mechanical principle, and true to the adaptation of means to purpose, and of effort to effect, which we so constantly find in nature. The dam straight across is the shortest possible, and therefore costs the least labour; but it is the one upon which an equal volume and velocity of water would act the most powerfully: therefore it is used in those cases where the force of the current is least. The oblique or curved dam is more laborious in the construction, because it must be longer for the same breadth of river; but as the action of the water upon it diminishes in proportion to the obliquity with which the current meets it, it resists better than the straight dam, and its resistance increases with its obliquity: therefore it is used against the more rapid and powerful currents.

But notwithstanding this perfect accordance of instinct with those principles, on account of a far less perfect degree of which, human engineers are apt to be somewhat vain of their science, the beaver is not nature's master. There are combinations of circumstances, in which the beaver and his dam form no part; and when these occur, the flood comes rolling on in its power, and not only breaks down the dam, but sweeps away the habitation of the beaver, and all the store of his winter wealth. So true is it that when, in the single instance, reason or instinct appears to our understanding of the matter to have done its best, something unknown to us (though not unknown to nature) comes round and hurls to destruction all that reason plans in the one case, or that instinct executes without plan in the other; and when we imagine that we have established our position upon the surest basis, our philosophy is driven to the humbling observation of the poet,

> " The best-laid schemes o' mice an' men,
> Gang aft aglee ; "

while we can say no more about the matter than simply that such is the fact.

The huts of the beavers are constructed of the same materials as these dams. These houses are immediately on the bank, if that is moderately high, and the water proportionally deep, which are circumstances which usually go together; but if the bank is low and the water shallow, they chance a situation a little farther off. This appears to be in order that the floor of the hut, which is always excavated a little below the surrounding surface, may be above the height of the ordinary floods. The securing of a uniform temperature, not too low, appears to be the cause of the partial excavation of the hut; and the same practice is followed by the people of the north, when they form their winter habitations of earthy matters, and not of snow. The houses of Iceland, the Feroe islands, and the original ones of Shetland, the Hebrides, and even many parts of the Highlands of Scotland, are formed by partial excavation; and though they do not accord with southern notions of a comfortable dwelling, they are much more uniformly warm in winter and cool in summer, than houses raised entirely on the surface, or with their floors elevated above it. These houses are generally entered by a long and low porch, which is the case with the houses of the beavers, though the entrances of them are at some distance below the surface of the water.

When a family or society of beavers begin to construct a house (for houses are not made by solitary ones), they at first dig a foundation proportional to the number which it is to accommodate; and the walls are formed of the earth and stones which are dug out of the foundation, mixed with billets of wood, crossing each other, and thus binding or tying the other materials, so as to prevent them from being separated by the weather. The walls are made of considerable thickness, and so compactly put together, and all the interstices so filled with mud, that they are both water and air tight. When the walls have been raised to the proper height, they are closed in by a sort of dome roof, so that the structure is externally something in the shape of a hay-cock. The centre of the floor is a little raised, so that the place where the animals repose may be dry, notwithstanding any moisture which may trickle down the walls. Of this, however, there can be but little, owing to the compactness of the fabric. The principal entrance or entrances (for there are sometimes two, or even more) are below the surface of the water, to which they extend sloping from the edifice itself, and generally have the opening about three feet below the surface, which, in average situations, secures the animals an access to the water, notwithstanding the frost. A water entrance of this description is called "the angle," by the beaver hunters; but besides these, there is usually, and probably in all cases, a smaller opening toward the land. Without this last there would be danger of suffocation. There does not, however, appear to be any current of air, so that, even in very severe weather, the habitation of the beaver must be snug and warm.

Authors have stated that these houses have sometimes more than one story, and that they are divided laterally by partitions; but there does not appear to be any truth in the statement. Their houses are, upon the whole, very rude structures, far inferior to the nests of some birds, which have no working tools, save the mandibles of their little bills.

The winter stores of provisions, which consist of branches of trees, from which the animals gnaw the bark for their subsistence, are placed in the water close by the "angle," or entrance porch. Where there is a current they are placed above the entrance, and fastened with stones ; but where the water is comparatively still, either by being a lake, or from the existence of a dam, they are placed indiscriminately. When the party inhabiting the same house is numerous, the store of provisions is considerable, consisting of a cart load of twigs and branches. The store is said to be a joint collection by all the inmates of the house, but by them only, though the colony should, as it sometimes does, consist of a village of a dozen houses or more. The house is also the work of those only by whom it is to be inhabited ; but the dam is a work of joint labour. The celerity with which they build the latter, and especially with which they repair any injury which it may sustain, is wonderful, as compared with the slow progress of works of proportional magnitude among men ; but it is not more wonderful than that by which ants repair any injury which is done to their hills. There is one circumstance in the construction of these dams which our mechanical knowlege very imperfectly reaches or explains ; and that is, how, considering the light materials of which they are composed, and the total absence of piles, or any other means of protection, they get them to stand till they are closed. It is true that they are never erected in very rapid currents, and that the time of their erection is one in which there is but little risk from floods and inequalities of the rivers ; but still, if even a clever engineer were called upon to build of similar materials such a dam as the beaver builds, and to build it in the same manner, he would find many difficulties in the execution. It does not appear, either, that the current or fall of water over the beaver dams acts behind the foundation, which is very apt to be the case with dams and weirs of human construction, unless they have a "*tail*" of solid pavement carried out to a considerable distance, with its longitudinal section something in the parabolic form ; and even then the duration of the work appears to depend as much, at least, upon the strength of the materials as upon the mechanical skill which regulates the form of the work.

Thus, viewed in all their bearings, the mechanical labours of the beavers are, assuredly, not less wonderful or worthy of study, when we take them simply as animal labourers, than when we strain the imaginary comparison between them and the *contrived* works of man, to the very utmost pitch to which romancing and extravagant fancy has ventured to go ; and there is this advantage in the plain and rational study of them, that they contain something yet to be known, which cannot fail in being useful to us when we do know it, whereas we can learn nothing from the romance which judges of them from human art as the standard. The structures formed by these animals vary with the situations in which they are placed ; but the highly graphic representation by Landseer, on the plate "Beavers," will give a very good general notion of both the scenery and the habitation.

Even in those situations where beavers do not require to range far from their winter habitations during the summer, they do not then make use of them as places of rest. They generally form small detached burrows in the banks, and these, like their winter houses, often have their entrances under water. It seems, indeed, that beavers, as might indeed be supposed by their aquatic powers of locomotion being superior to their land ones, prefer journeying by water in all cases where the journey is of considerable length. They are thus bank animals even at that season when they depend upon the growing produce of the land. In this respect they bear some resemblance to those cetaceous animals (to the lamantines, for instance) which inhabit the large rivers in the tropical parts of the world which reside chiefly in the water during the day, and come on shore to browse the vegetation on the banks, during the night or in the twilight. Like these, the beavers are nocturnal feeders, and are seldom on land during the heat of the day, though they spend more of their time in their resting places than in the water, whereas the herbivorous cetacea take their rest in the shallows of the rivers. Beavers are, indeed, fond of sporting in the water, although it is only a pathway and a means of floatage to them, and not a pasture from which they immediately derive their food. But this is what we might suppose ; for living as the beaver lives, and feeding as it feeds, the water is necessary to its existence ; and it is a general, and, at the same time, a very benevolent and beautiful law of nature, that whatever is in ordinary circumstances necessary to the well-being of an animal, affords it pleasure in proportion to the necessity. This pleasure does not consist in the mere *utility;* as, for instance, the pleasure of the water to the beaver does not arise from the food which that element enables it to reach, or from the building materials which that element enables it to transport. The pleasure is in the mere fact of swimming in the water ; and if it were a case in which we could at all admit the relation of cause and effect, we would be much more correct in saying that the pleasure is the cause getting the food and the materials, and not the desire of possessing these the cause of the pleasure.

And we ourselves may here learn of the beaver : "Go to the beasts, and they shall teach," says an author of high authority ; and one equally high puts this question : "Is not the *life* more than meat, and the *body* than raiment?" This last instruction is put in the form of a question, in order more forcibly to draw our attention to it ; for He by whom it is put knew every instinct of nature and every thought of man, and thus stood in need of no confirmation. When "the life," in man, is in this manner put in opposition to, or as distinct from, "the body" it always means the intellectual part—that which can learn, and know, and think ; and in the passage above quoted, the contrast of "the body" with "raiment," is that of the exercise of our faculties with all those things which, under the name of wealth, the exercise of our faculties procures or accumulates. The first part of the lesson, that which relates to the intellectual power, is to man only : the second is to every creature, though man is the only one to whom it needs to be repeated. Those creatures depart not from their instincts. The pleasure of the beaver, for instance, is on the bank or in the stream, and he attempts not to wander over the thirsty plain, or to climb the rugged mountain. A being of matter, and of such life only as can exist in matter, all his faculties, and all their operations, are as determinate under the circumstances which admits of their existence, as the falling of a rock is when the lightning shatters it from the perpendicular cliff. Accordingly, neither the beaver nor any other animal ever sacrifices its true enjoyment for the purposes of folly or of avarice. The instinct of the beaver leads him to accumulate a bundle of sticks for his winter provision; but the beaver never thinks of accumulating in one year a stock which shall last him for twenty; neither does he seek to become a great beaver among beavers, "in proportion to the magnitude of his heap," and look with scorn upon the rest of the village, because he has a few sticks more than they. Still, when the season requires it, the beaver slackens not the hand of his industry; and unless when a casualty of nature, which his instinct does not reach—such as an excessive frost, an overwhelming flood, a parching drought in the summer, or one of those fearful conflagrations which sometimes lay the natural forests in ashes, and cause the pools to boil like cauldrons, overtakes him, there is plenty, as well as peace and happiness, in his dwelling. Turn from the hut of the beaver to the dwelling of man, and be it cottage or be it palace, say if the parallel holds. The record forbids the affirmative, for, taking it from day to day, or from age to age, a full third of it is the recital of crime, and more than another third the recital of misery.

And wherefore is it so? Clearly for this reason, that in man, and in man only of all creatures, there is a departure from the law, a violation of some of those statutes or principles, the full operation of all of which would make the life of man, as it makes the life of every other creature, one continued scene of enjoyment. This deviation can take place only in the intellectual part of man's nature; for, make a beast of him, and, either there is no consistency or meaning in nature, and no use in studying any thing about the material creation, or he would be as faithful to his instincts as other beasts. Thus man's deviation from the law of nature, as proved by his crimes and their necessary punishments,—(for, though men often remain ignorant of the crime or spare the guilty, nay, though they often raise error and absurdity to the seat of wisdom, and fall down and worship them there, nature never does),— is at once an irrefragable proof of the intellectual part of his nature, and a ground of very bitter self-humiliation—unless the bitterness is made to become sweet, by finding out what should be the course, and steadily following it.

Now, as the things of this world are for this world only, it is clear that the accumulation of them should be a secondary operation with man—inferior to the exercise of the intellectual or higher part of his nature, and therefore it should always be made to give way to that. Not only so, but in the conducting of it, man should follow the general law of the animals; because each of them is for this world as much as he is, materially speaking, and some of them are for it during a longer period. Consequently, even in the acquiring of that which is necessary, the powers exercised in the acquisition, or, in other words, the exercise of those powers, should be man's chief pleasure, and he ought never to allow them to diminish, or in any wise interfere with the natural charities of his kind. The beaver collects his bundle of sticks; but in doing so these animals never abandon their young, neither do they, by gloomy (and blasphemous) anticipations that God shall in time become unable to provide for all beavers that may be born, take moral or immoral means of either preventing an increase or diminishing the present number. Beavers do indeed establish new colonies; but there are no commissioners or land agents among them; they work exactly to the circumstances of the place and the time, and therefore they work all-enjoyingly; and their population can at no time be said to be redundant or defective. We, on the other hand, taking a fraction, and generally a very small fraction, of the case, legislate not only for the laws of nature but for the succession of time, and we need not wonder that the statutes which we thus frame are as senseless as the framers. Such is the beginning of the lesson which the beaver teaches; but we shall not pursue it farther, as the introduction into works on natural history, of such deductions, though really the most useful part of the subject, is not yet sanctioned by the custom of authors.

In an economical point of view, the beaver is a very valuable animal. The fur is more glossy and beautiful than almost any other of the same fineness; it takes a rich black colour, without having its gloss in the least destroyed; it wears well, and is not much subject to injury from rain; and it very readily unites into a strong, though light and flexible fabric, by the operation called *felting*. Hats are put together by that operation, unless very inferior ones, in which glue is applied in supplement, which of course spots the hat, and refreshes with its unctuous droppings the head of the wearer during rain; and the fur of the beaver has those qualities which render it a much better material for hats than any other which is known. Accordingly it was very early used for this purpose; and so exclusively used, when hats were fewer and beavers more numerous, that both the English and the Latin name of the animal became synonimous for the article of dress. At one period it was deemed necessary to enact statutes for preventing the admixture of any other material with the fur of beavers in the manufacture of hats; and at that time the hat outlasted the wearer, and could be washed in the same manner as a piece of woollen cloth; but in more modern times, owing partly to the great decrease in the number of beavers, and partly to the increased demand for hats, the article is so expensive that no hat is made entirely of beaver. The body is formed of wool, and that is plated over with beaver, which is worked fully through the body, or "felt," in good hats, but only very partially in inferior ones. A shower takes the beaver off the latter; and it is not very long in wearing bare, and showing the felt in the former.

The skin of the beaver is also used in the manufacture of gloves, and sometimes in that of shoes, though in the latter case the shoe, like the bad hat, requires a little glue to make it saleable. Even the gloves are of very inferior quality, as the skin is thick and very rough and loose in the texture; so that if it were not for the fur, the beavers would not be deprived of their lives for the sake of their skins.

There is another part of the beaver which is used in medicine, though not so largely at present as formerly. It is a peculiarly unctuous product, secreted by a follicle immediately under the tail of the animal. It has a very disagreeable smell and nauseous taste, but it was once in high request as an antispasmodic, and also as producing an important and specific action on the uterine system. It is still retained in the Pharmacopœia under the name of *castoreum*, or castor. It is not our province to examine its virtues as a drug; but we may observe that it was introduced into medicine at a time when nostrums were held as being beneficial, very much in proportion as they were nasty; and to what extent this may be the case still, is also without our province.

In consequence of these uses in the arts, the beaver has been hunted with great assiduity; and some idea of the total quantity killed in all parts which beavers inhabit may be obtained from the fact that, in the year 1808, there were 126,927 brought to this country from Canada alone.

Many stratagems are resorted to for the capture of an animal so much in request, but we shall notice these very briefly.

The skin of the cub-beaver is more highly prized than that of older animals, as being darker and more glossy; the winter season is preferred for capturing them, on account of the superiority of their coat at that time. There are various means employed in taking them. One of the ways in which they are captured is, by boring a number of holes in the ice, when they are driven from their habitations, which are then destroyed. They remain under water a short time (as they are incapable of remaining in that element for any very protracted period), then by rising to the surface where the ice is broken, they are easily taken. At these times many of them retreat to the holes in the banks, where they lodge in summer; but these vaults are soon discovered by experienced hunters, by striking on the ice with chisels, and they select such spots for their openings as they know will readily lead to the capture of their victims, and they are seldom mistaken. Another way in which they are taken is, to cut the ice both above and below their dwellings, nets are then thrown across, and the animals are driven from their abodes and compelled to enter the nets. It is usual, in summer, to take them in their houses, by what is called staking them. To effect this purpose the hunters first make an opening in the roof, in order to discover the exact position of the angle, and having adapted a number of stakes to the opening, so as to completely blockade it, they cover in the top and leave the stakes on one side ready for use. This done, they drive the beavers, by means of dogs, from all parts of the pond or river; and when the affrighted and hunted animals have succeeded in reaching their homes, they again put up their stakes before the door-way, take off the temporary covering from the roof, and either take them in a living state or spear them in their habitations. When they inhabit a sheet of water, which is merely kept up by a dam, they are still more readily taken, by letting off the water, and leaving their huts quite dry. The gun is also sometimes, though not very generally, used; and log-traps, baited with poplar sticks, are now and then made use of, to commit havoc among them.

The following account of a tame beaver was furnished by its owner, Mr. Broderip, to Mr. Bennet of the Zoological Society, when that gentleman drew up his account of "The Gardens and Menagerie;" and we have quoted it because Mr. Bennet's work is not so much known to the public as its merits deserve:—

"The animal arrived in this country in the winter of 1825, very young, being very small and woolly, and without the covering of long hair which marks the adult beaver. It was the sole survivor of five or six, which were shipped at the same time, and it was in a very pitiable condition. Good treatment quickly restored it to health, and kindness soon made it familiar. When called by its name, "Binny," it generally answered with a little cry, and came to its owner. The hearth-rug was its favourite haunt, and thereon it would lie stretched out sometimes on its back, sometimes on its side, and sometimes flat on its belly, but always near its master. The building instinct showed itself immediately it was let out of its cage, and materials were placed in its way; and this before it had been a week in its new quarters. Its strength, even before it was half-grown, was great. It would drag along a large sweeping-brush, or a warming-pan, grasping the handle with its teeth, so that the load came over its shoulder, and advancing in an oblique direction till it arrived at the point where it wished to place it. The long and large materials were always taken first, and two of the longest were generally laid cross-wise, with one of the ends of each touching the wall, and the other ends projecting out into the room. The area formed by the crossed brushes and the wall he would fill up with hand brushes, rush baskets, books, boots, sticks, cloths, dried turf, or any thing portable. As the work grew high, he supported himself on his tail, which propped him up admirably, and he would often after laying on one of his building materials, sit up over against it, appearing to consider his work, or, as the country people say, 'judge it.' This was sometimes followed by changing the position of the material 'judged,' and sometimes it was left in its place. After he had piled up his materials in one part of the room (for he generally chose the same place), he proceeded to wall up the space between the feet of a chest of drawers which stood at a little distance from it, high enough on its legs to make the bottom a roof for him; using for this purpose dried turf and sticks, which he laid very even, and filling up the interstices with bits of coal, hay, cloth, or any thing he could pick up. This last place he seemed to appropriate for his dwelling: the former work seemed to be intended for a dam. When he had walled up the space between the feet of the chest of drawers, he proceeded to carry in sticks, cloths, hay, cotton, and to make a nest; and when he had done he would sit up under the drawers and comb himself with the nails of his hind feet. In this operation, that which appeared at first to be a mal-formation was shown to be a beautiful adaptation to the necessities of the animal. The huge webbed hind feet of the beaver turn in so as to give the appearance of deformity, but if the toes were straight, instead of being incurved, the animal could not use them for the purpose of keeping its fur in order, and cleansing it from dirt and moisture.

"Binny generally carried small and light articles between his right fore-leg and his chin, walking on the other three legs; and large masses, which he could not grasp readily with his teeth, he pushed forwards, leaning against them with his right fore-paw and his chin. He never carried any thing on his tail, which he liked to dip in water, but he was not fond of plunging in the whole of his body. If his tail was kept moist, he never cared to drink; but if it was kept dry, it became hot, and the animal appeared distressed, and would drink a great deal. It is not impossible that the tail may have the power of absorbing water, like the skin of frogs, though it must be owned that the scaly integuments which invests that member has not much of the character which generally belongs to absorbing surfaces.

"Bread, and bread-and-milk and sugar, formed the principal part of Binny's food, but he was very fond of succulent fruits and roots. He was a most entertaining creature, and some highly comic scenes occurred between the worthy, but slow beaver, and a light and airy macauco that was kept in the same apartment.

"An animal so sociable in his habits ought to be affectionate, and very affectionate the beaver is said to be. Drage mentions two young ones which were taken alive and brought to a neighbouring factory in Hudson's Bay, where they throve very fast, until one of them was killed accidentally. The survivor instantly felt the loss, began to moan, and abstained from food till it died. Mr. Bullock mentioned to the narrator a similar instance, which fell under his notice in North America. A male and female were kept together in a room, where they lived happily till the male was deprived of his partner by death. For a day or two he appeared to be hardly aware of his loss, and brought food and laid it before her; at last, finding that she did not stir, he covered her body with twigs and leaves, and was in a pining state when Mr. Bullock lost sight of him."

Notwithstanding the length of time that the beavers have been known to commerce, the numbers of them that have been captured, and the long accounts which have been drawn up of the parallel between their dam and hut building, as compared with the same operations in man, there are some parts of their real and proper history which still remain in a great measure undetermined.

Among these are, the length of gestation in the females, and the season at which the young are brought forth. The general habit of the order is short gestation; and from the size of cub beavers when brought to this country, and the season at which they have been brought, it is natural to suppose that the young are brought forth in the very warmest season of the year. There is another reason why that should be the case. Animals in a state of nature, generally produce their offspring, or have them in a very young state, at that season when their proper food is in the greatest abundance. The apparent exceptions to this, are in reality no exceptions at all. The bears, which, at first consideration, appear to be the most striking exception, as the females not only bring forth their young in the winter retreats, but suckle them for some time there, not only have an accumulation of fat sufficient for the support of both dam and cubs, till they are able to follow her in ranging, but they come abroad when the "harvest" of the winter's desolation, the ruin occasioned by the storms of winter, is the most abundant and most easily found.

Winter directly produces no superabundance of food for the rodentia; nor is it till the season of growth has made some advances, that there is moisture in the bark. When, in the latter part of the year, the *cambium* ripens, the bark is dry, until the leaves are so far developed that their action commences. This may be one reason why beavers cut their winter provision before the bark has attained its most sapless state, and it is also a reason why the whole period of gestation in the rodentia is thrown into the spring season, and their bringing forth into the latter part of the spring or the autumn.

In the absence of certain information, we cannot, of course, speak positively, but the probability is, that beavers, to a considerable extent, follow the law of shore birds, which congregate in winter, and disperse against the pairing time. The period of their gestation is, of course, longer than that of the incubation of birds; and that carries the time of their bringing forth, nearly to that season at which the young twigs are in the fulness of their growth, so that when the cubs begin to seek their own food, they find it in the greatest abundance and perfection.

This is rendered probable, nay certain, by the immature state of the cub beavers during the prime of the hunting season, which is the latter part of the winter; and it is confirmed by the stage of growth at which they have been imported to this country, as established by the case of the individual of which we have quoted the account.

Though beavers, and indeed most of the class of animals to which they belong, are easily tamed, they are, when brought alive to this country, sometimes subjected to the wantonly cruel operation of blinding. This is said to be done with a view of keeping them from the water, into which, if they once escape, they do not readily return to the state in which they previously are.

Those which are at the Zoological Gardens have been nearly blinded, though one of them still possesses the sight of one eye, at least partially. They are provided with water and a house, and also with food, so that they can only indicate their natural propensities; and the loss of the eyes makes those indications very imperfect. Still they show the building propensity; and at the season when beavers, in a state of nature, construct or repair their habitations, these not only carry sticks which are thrown into the water for that purpose, but carefully inspect their artificial house, fetching clay and mud from the bottom of the pond, and plastering every crevice so carefully over as to render their habitation not only weather-proof, but air-proof at all places except the entrances.

It is to be regretted that these, the most accessible to the public of any specimens of this interesting species to be met with in the country, have been blinded, because that must necessarily prevent the display of some of their habits, though fewer of them, perhaps, than in most animals, as beavers perform their most curious labours during the night. It were to be wished that some of the proprietors of land who have large parks intersected by such streams, or containing such sheets of water, as beavers frequent in a state of nature, would establish beaver preserves. The creatures would be highly curious and ornamental; their flesh, if fed upon succulent plants, would probably be found more nutritious than that of hares, and their fur is certainly far more valuable. Now it should seem that, even as a matter of economy, it would be much wiser to give up a few acres of osier-holt along the margin of the waters to a colony of beavers than to keep preserves of hares and pheasants, which animals plunder the crops for miles round.

BEDEGUAR. An excrescence frequently found growing upon various species of roses; especially of the wild kinds, of a fine green or pink colour, and covered with branched hairs. This excrescence is a species of gall, caused by the deposition of the eggs of a small fly, belonging to the genus *Cynips* of Linnæus, in the substance of the twig, and when opened is found to contain the grubs or pupæ, in considerable numbers, of the fly. It is perhaps one of the most singular circumstances in the economy of the insect world, that a fly, scarcely more than one-twelfth of an inch in length, is able to inflict a wound, from which an excrescence often a couple of inches in diameter is produced. The subject, however, will more appropriately come under our notice in the article CYNIPS or GALL FLIES.

BEE. The English name for all those species of hymenopterous insects which compose the very extensive Linnæan genus *Apis*, or the section *Anthophila* or *Mellifera* of modern classifications; and which, as already stated under the article *Apis*, consists of two distinct families. In the present article we purpose confining ourselves to the domestic bee, the *Apis mellifica* of Linnæus, and which, with some exotic species possessing similar habits, constitutes the restricted modern genus *Apis*.

It may be convenient, in the outset, to state that the hive-bee is distinguished from all the other species of bees, by having the shanks of the hind legs furnished with a smooth and concave pollen plate on the outer surface, and destitute of spines at the extremity; by the basal joint of the tarsi, in the workers, being of an oblong form, with its inner surface clothed with fine hairs disposed in transverse layers; by the oblong shape of the body; by the maxillary palpi, or the feelers of the sheaths of the tongue, being almost obsolete and formed of a single joint, and by the oral apparatus being of an elongated form.

The hive-bee may be regarded as one of the most perfectly social species of insects, and one, whose economy is regulated by the possession of a more perfect degree of instinct than is perhaps possessed by any other invertebrated animal. Another peculiarity, necessarily dependent upon the social habits of these insects, is the existence of individuals which have been regarded by many as a third sex, but which modern investigations have ascertained to be female insects, whose internal and sexual organisation is in an undeveloped state. These individuals, neu-

Neuter Bee.

ters or mules, or workers, or female non-breeders, as they have been termed, constitute the great mass of the population of a society: they are the smallest members in the community, a circumstance probably dependent upon their imperfect organisation (if we may be allowed to use the term to an animal possessing such perfection of habits); and it is to them that the internal economy of the hive is committed, and upon them the whole labour of the community devolves.

> How skilfully she builds her cell,
> How neat she spreads her wax,
> She labours hard to store it well
> With the sweet food she makes—
> She gathers honey all the day
> From ev'ry opening flow'r.

Moreover it is their duty to guard and protect the hive and the queen, to feed the young, and to kill the drones at the appointed season.

In a single hive, there are sometimes not fewer than 30,000 of these individuals. They are distinguished from the fully developed females by having a longer lip, the jaws not notched at the tip, and the sting straight.

The perfect female, of which there is but a single individual in a hive, is termed the queen, and is distinguished by her greater size, more elongate form, brighter colour, shorter tongue, notched jaws, and curved sting. Her duty principally consists in the laying of eggs, and in her proceedings she is attended by a body guard of workers, who pay her the greatest attention; hence, she is the mother of the hive, not indeed of the contemporary generation, but of the future inhabitants of the hive, as well as of the swarms of the following summer. It is one of the most curious points in the history of this insect, to notice the immense influence which this solitary female has upon an entire population of many thousand bees. And, indeed, did not the accounts which have been given respecting it, depend upon authors of the most undisputed veracity, it would be next to impossible to consider them to be otherwise than as most marvellous and impossible *fables*. Reaumur, however, by dividing a hive, clearly proved the existence of the more than careful attention and respect with which the queen is regarded. He inclosed the two portions of the society in glass hives, and ascertained not only that such was the case, but also, that whilst in that division which possessed the queen, and but a small proportion of workers, the latter quickly made two combs, the portion without a sovereign, although far more numerous, did not construct a single cell; whence it is evident that the instinctive proceedings of the workers depend on the love of progeny; and what is the more remarkable, it is not for their own offspring that they are content to undergo all their labours, being totally incapacitated from becoming the parents of a hive.

Queen Bee.

The absence of the queen deprives the workers of no organ, paralyses no limb, yet in every instance that they are deprived of her they neglect their duties, and unless provided with another queen they refuse food and quickly perish. How difficult is it to attribute these wonderful proceedings to any other cause than the possession of the most perfect reason.

The male bees, of which there are several hundreds, sometimes even two thousand, in a full hive, are idle creatures, doing no work:—

> On other's toils, in pampered leisure thrive
> The lazy fathers of the industrious hive.

Their only duty is to impregnate the female, and this effected, they are driven from the hive and killed by the workers, who thereupon also destroy the male larvæ and pupæ remaining. They are generally termed drones, a term which has been misapplied to various species of flies which indeed much resemble bees, but which may at once be distinguished by having only one pair of wings.

These drones are of a more bulky size than the other bees, and they are not armed with a sting. Their antennæ are composed of thirteen joints (those of the females and workers having only twelve articulations); the head is more rounded, with the eyes larger, and meeting behind; their jaws are smaller and very hairy; and the basal joint of the posterior tarsi has neither pollen plate nor brush. They make a much greater noise in their flight than the others, and at the extremity of the body two small corneous appendages are to be observed of a yellow colour, which, with some other internal organs, constitute the sexual apparatus.

Drone Bee.

In addition to these three kind of individuals, it is to be observed, that there appear to be two sorts of females, namely, the large and small. Reaumur, however, attributes this difference of size to the state of the eggs in the body. There are likewise two descriptions of males, one not larger than the workers, and supposed to be produced from a male egg laid in a worker's cell, and the other much larger, above described. Moreover, there are, according to M. Huber, two sorts of workers; the first, which he calls cirières, wax-makers, being charged with the collecting of food and secretion of materials for the building of the nest; and the second, which he calls nourrices, or nurses, smaller and more weakly, whose cares are directed to the feeding of the young and the domestic concerns of the nest*. Huber also noticed another kind of bees, which he terms black bees, and which appear to be only casual inmates of the hive, from which they are always expelled, and often killed by the workers, with which, however, except in having the head and thorax of a darker colour, they agree both in their external appearance and internal structure, having, like the workers, perfect ovaries, although not furnished with eggs. Messrs. Kirby and Spence threw out the hint that those black bees may be superannuated workers, which have lost some of the hairs from off their bodies, and which, being incapable of contributing to the labours of the nest, are banished by the younger members.

Such are the inhabitants of the hive—the chief products of which are bees-wax and honey. The former is secreted by the worker-bees from a peculiar apparatus on the under-side of the belly, as occasion requires†, and is employed for constructing the combs in which the family-provision and the young brood are deposited. These combs are boiled in water, after the honey is extracted, until melted; the wax is then separated from the water, and being remelted, it is poured into moulds, to form the bees-wax sold in our shops. It has been said that there is hardly enough of this article produced in England to answer the demand for lip-salve alone, the greater portion employed being annually imported from the Baltic, the Levant, the Barbary coast, and North America. Humboldt informs us that not less than 42,670 arobas of wax, worth upwards of 130,000*l.* were exported from the island of Cuba in a single year. This product is for the most part obtained from the common hive bees; a quantity by no means inconsiderable is, however, procured from various species of wild bees.

Honey is obtained by the bees from the nectaries of flowers, which, as is well known, are constantly secreting a sweet nectarial fluid. This is sucked up by the tongue of the insect; a portion of it is consumed at once for its support, but the majority of the supply, although taken into the stomach of the bee, is again regurgitated and poured into the cells of the hive for the food of the grubs and the use of the community during winter. These cells are placed in the most inaccessible parts of the hive, and are closed with waxen lids, but the honey destined for the use of the nurses, workers, and drones, is deposited in unclosed cells. Some difference seems to exist whether the honey, whilst retained in the stomach of the bee, does not undergo some change, and this idea is strengthened by Reaumur's experiment, from which he obtained honey from the nests of bees fed upon sugar. Moreover, in each honey-cell there is a cream-like layer or covering of a thicker consistence than the honey itself. This layer is perforated by the bee, when it deposits its honey in the cell, through a hole made by the fore-legs, and which is closed before the bee flies away. The quality and taste of honey depend, therefore, upon the plants frequented by the bees; thus, the finest flavoured and most delicate honey is collected from aromatic plants, and has been stored in clean and new cells, for which reason, and not because it is elaborated by a fresh swarm of bees, it is termed virgin honey. The peculiar taste of the fine Narbonne honey has been attempted to be imitated by adding an infusion of rosemary. Hence it is advisable to have large patches of such plants as borage, viper's bugloss, mignonette, lemon thyme, and sage, in the neighbourhood of bee-hives. Lime trees, furze, heath, and clover, are also desirable auxiliaries.

Honey, however, occasionally has been found to have acted like poison, a circumstance probably owing to the bees having extracted it from poisonous plants. Many of the ancient writers contain facts on this subject, and in particular Xenophon has recorded in his Memorabilia that a number of Greek soldiers, during the celebrated retreat of the ten thousand, were violently affected by honey, which they had eaten near Trebizond. Tournefort, when travelling in Asia, made some inquiries upon the subject, and discovered a shrub growing in the neighbourhood of that place, which is well known to produce similar effects. He says, "There is a kind of rhododendrons about Trebizond, whose flowers the bee feeds upon, and the honey thence drives people mad." Moore has employed this circumstance,

* Much difference of opinion has prevailed amongst naturalists as to the origin of wax, it having been generally supposed that the yellow matter, which in fact is the farina of flowers, and which is collected upon the thighs of bees, was its prime constituent. More recent investigations have, however, pretty clearly demonstrated, that wax, by the organic intervention of bees, is produced from honey having been repeatedly secreted when the bees have been confined in rooms, where they could not possibly obtain the least particle of farina, which has been termed bee-bread, or the ambrosia of the hive, and which having been collected by the workers, is deposited by them in the cells. The wax is secreted by a singular series of organs between the abdominal scales, Mr. John Hunter having detected the genuine reservoir of wax under the bee's belly.

† It is not improbable that the assertion of Father Tanoya, mentioned by Monticelli, that in every hive there are three sorts of bees independent of each other, namely, male and female drones, male and female monarchs, and male and female workers, originated in these several kinds of bees; but that each construct their own nests, as he asserts, is certainly unfounded in fact.

in his "Lalla Rookh," in a most forcible and poetic manner:—

> Just Alla! what must be thy look
> When such a wretch before thee stands
> Unblushing, with thy sacred book,
> Turning the leaves with blood-stained hands,
> And wresting from its page sublime
> His creed of lust and hate and crime?
> Ev'n as those bees of Trebizond
> Which from the sunniest flowers that glad
> With their pure smile the gardens round,
> Draw venom forth that drives men mad.

It is probable that the plant in question is the *Rhododendron ponticum*, or the *Azalea pontica* of Linnæus.

Dr. B. S. Barton, in a valuable paper in the Fifth Volume of the Transactions of the Philosophical Society of America, after detailing the statements of classical authors upon the subject of poisonous honey, has stated that, in the autumn and winter of 1790, the honey collected near Philadelphia proved fatal to many, in consequence of which it was discovered, after an inquiry instituted by the government, that the honey had been chiefly collected from the flowers of the *Kalmia latifolia*. He also mentions that a party of adventurers removed some hives of bees from Pennsylvania to New Jersey, in the hope that the savannahs of the latter country might be favourable to the increase of these animals, and, consequently, to the making of honey; they accordingly placed them in the above situations, and where the *Kalmia angustifolia* was the principal flowering shrub; the bees increased prodigiously, and the enterprise appeared successful, but it was soon found that every one who ate of the honey became intoxicated to a high degree. It was then made into metheglin, but with a similar effect to those who partook of it. The usual symptoms were a dimness of sight, or vertigo, succeeded by a delirium, which was sometimes mild and pleasant, and sometimes ferocious; intoxication, pain in the stomach and intestines, convulsions, profuse perspiration, foaming at the mouth, vomiting, purging, and, in a few instances, even death. Sometimes vomiting was among the earliest symptoms, and in that case the patient was readily relieved, although a temporary weakness of the limbs was not an uncommon result.

Dr. Hosack has recorded two cases in which this substance produced violent vomiting, a coldness at the extremities, and a livid appearance of the countenance. The pulse was reduced to about twenty in a minute; the spontaneous vomiting, however, being followed by a dose of castor oil, together with the application of fomentations, relieved the sufferers. In these cases the honey was of a dark reddish colour, and a thicker consistence than usually sold in the market.

From the facts mentioned above, Dr. Barton is of opinion that the poisonous nature of the honey is owing to the bees feeding on poisonous plants, such as the *Kalmia* of various species, the *Andromeda Mariana*, which is injurious to sheep, the *Rhododendron*, the *Azalea mediflora*, and the *Datura*, and he recommends that every fœtid or poisonous vegetable should be removed from the habitations of these animals.

Thus it will be seen that, as Dr. Barton observes, there is more of poetry than philosophy in the following lines of Pope,—

> In the nice bee what sense so subtly true,
> From poisonous herbs extracts the healing dew?

Adding, "It is, however, much to be questioned whether this noxious honey proves so to the bees themselves." This, it may easily be conceived, does not take place, since the bees would most undoubtedly have the instinct to avoid the plant, and in the case of the Philadelphia bees, they are said to have thriven prodigiously. The case is, however, very different with them in respect to other flowers and fruits, which act upon them in a manner greatly resembling the effects of intoxication. Thus an elegant modern writer, cited by Dr. Bevan, after defending animals in general against the impropriety of the expression that a man who has drank to such an excess as to lose his reason, has made a beast of himself, observes, that it may fairly be said that he has made a *humble bee* of himself, for those little debauchees may often be observed round the nectaries of hollyhocks, quaffing as pertinaciously as though they belonged to Wilkes's Club, whilst round the flower on the ground several of the *bon vivants* will be found lying inebriated and insensible. Other observations have been made to the like effect.

Various plans have been of late years adopted to obtain the honey from bee-hives without resorting to the cruel, and, as it seems, unnecessary practice (which is, however, still usually adopted in this country) of sacrificing the lives of the bees, by placing the hive at night over a hole, in which lighted brimstone matches are placed, the fumes from which in a short time kill the bees.

> Sudden the dark oppressive steam ascends,
> And, used to milder scents, the tender race
> By thousands tumble from their honey'd dome,
> Convuls'd and agonising in the dust.
>
> THOMSON.

The plans chiefly adopted have had for their object the expulsion of the bees from the old nest, after the combs are well filled with honey, into adjacent boxes, in which they then recommence their labours, or after the removal of the honey, they are again returned to their old habitation. We shall take this opportunity of mentioning a plan adopted by Mr. Nutt, an intelligent and practical apiarian of Lincolnshire, whose apparatus was lately exhibited at the Museum of National Manufactures in Leicester-square. By arrangements which, although very simple are very complete, a secretion of a much larger quantity of honey is caused than can be produced by any other mode of management. Three collateral boxes are placed side by side, with a single entrance in the centre box, which, however, communicates with the side boxes by apertures, which are easily closed by a tin slide. The bees are first introduced into the centre box; when this is filled with honey, which is allowed to remain for the use of the bees, in order to obviate the necessity of swarming, Mr. Nutt removes one of the slides, and establishes a communication with one of the side boxes, the temperature of the latter being regulated by a perforated tin tube, which acts as a ventilator, and by which means these additional store boxes are kept at a proper working temperature, and *below the generative heat*, in consequence of which the queen bee is always retained in the middle box. The heat of these side boxes is kept at 70° or 80°, whilst the natural temperature of the working hive is 90° or 100°, increasing even to 120°. When the temperature of the side boxes rises towards the latter point it is evident that they are full, and the necessity which exists for establishing a connexion with the centre and the other end box is thus shown. The bees are easily driven from the full side box by the action of the ventilator, when the communicating aperture is closed by means of the slide, and the first full side box is then removed; and the bees, finding the middle box full, soon make their way into the other side box. The ingenious action of the ventilator is designed to retain the queen in the middle box, since the reduced temperature of the side boxes prevents the queen from rendering them her domicile, whereby a great superiority both in the quantity and quality of the honey is obtained, as it contains none of the eggs, larvæ, pupæ, pollen, or bee-bread, which is found in the centre box in considerable quantities for the support of the young. By this means Mr. Nutt has procured the amazing quantity of 296 lbs. of honey from one stock of bees, the general average product being from 100 to 130 lbs.

But Mr. Nutt's own statement is so fully illustrative of the advantages of his system, that we furnish it in a tabular form:—

Pounds.			Pounds.
	First swarm on the 10th June, 1823.		
127	Union of the present stock,	14th Aug. 1823,	28
132	Collection of honey,	12th June, 1824,	30
109	Ditto .	16th July, 1825,	58
125	Ditto .	10th Aug. 1826,	106
105	Ditto .	10th July, 1827,	219
114	Ditto .	6th Aug. 1828,	296
712	For the bees' support during five years.		
737	Contribution	Contribution	737
1449			

Hence it is evident, that by this and other "humanity" systems, the comparative estimate given by Dr. Bevan of the advantages which are thereby obtained over the old single-hiving system is well founded; namely,

"Firstly, an economical division of labour, which causes a larger quantity of wax and honey to be collected than if the bees were to swarm and to carry on their operations in separate families.

"Secondly, the facility with which the bees may be deprived of a considerable portion of their honey without destroying their lives, or communicating to the honey any unpleasant flavour from the sulphurous gas.

"Thirdly, the power which is afforded to the bees of employing themselves usefully during wet weather.

"Fourthly, the saving of that time which is unnecessarily spent in the construction of the fresh combs in the new habitation, at a period of the year, it may be observed, when nature is most lavish of her flowers for the development of their sweets.

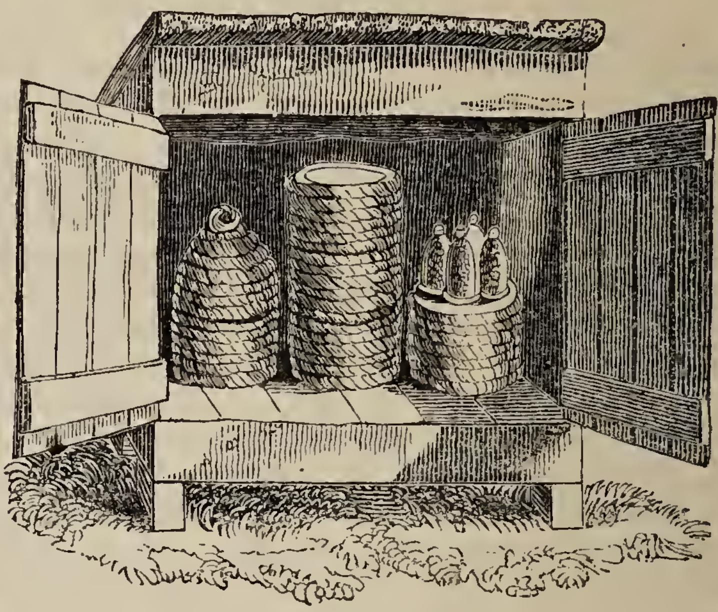
"Fifthly, the saving of room; for as every family has more warehouse room than its respective necessities require, the division into small families must multiply the proportion of this superfluous room.

"Sixthly, the saving of time usually lost in the preparations for swarming, when the bees hang inactively in clusters on the outsides of the hives for many days, sometimes for weeks, particularly if the weather prove unfavourable."

From honey is prepared a vinous fluid, heretofore much used in England, called mead, metheglin, or hydromel.

> Fill the *honey'd beverage* high,
> Fill the skulls, 'tis Odin's cry—
> Fill the *meath*, and spread the board,
> Vassals of the grisly lord.

This was, indeed, the chief wine of the old inhabitants of Britain. It was prepared in various ways, one of which may serve as an example. "Into twelve gallons of water slip the whites of six eggs, mix these well together, add twenty pounds of honey. Let the liquor boil an hour, and when boiled add cinnamon, ginger, cloves, mace, and rosemary; when cold put a spoonful of yeast to it, and tun it up, keeping the vessel filled as it works; when it has done working stop it up close; and when fine, bottle it off for use."



Apiary.

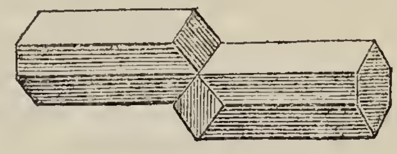
In the above engraving we give a representation of one of the modes resorted to for facilitating our acquaintance with the economy of the hive. Many of the most important discoveries connected with the habits of the bee have been made by the use of a glass-hive, and the one represented in the engraving combines all the comforts of a common apiary, with a complete facility of examination.

Having thus noticed the inhabitants and the products of the hive, we may now turn our attention to the hive itself. "The most profound philosopher, equally with the most incurious of mortals, is struck with astonishment on inspecting the interior of a bee-hive. He beholds a city in miniature. He sees this city divided into regular streets, these streets composed of houses constructed on the most exact geometrical principles and the most symmetrical plan: some serving for store-houses for food, others for the habitations of the citizens, and a few much more extensive than the rest destined for the palaces of the sovereign. He perceives that the substance of which the whole city is built is one which man, with all his skill, is unable to fabricate; and that the edifices in which it is employed are such as the most expert artist would find himself incompetent to erect." Such is the general description given by Messrs. Kirby and Spence; but we will descend to more minute particulars, observing that, although the hive and its inhabitants have formed the subjects of investigation from the earliest periods, its mysteries are not yet fathomed—it "is a miracle which overwhelms our faculties." In the first place it is to be observed, that the hive is but a convenience, not essential to the establishment of a nest, since bees, after swarming, will form their city in the hollow of a tree, or other cavity. Thus the scriptural riddle, "Out of the eater came forth meat, and out of the strong came forth sweetness" (Judges, chapter xiv.), may be solved by supposing that the carcass of the lion had become dried up, and formed a convenient cavity for the reception of the nest. And Montgomery, in his Pelican Island, also notices the propensity of these insects of establishing themselves in the dried and capacious skeletons of animals—where, speaking of the hugeness of the skull of the elephant, he says,—

> Bees, in the ample hollow of his skull,
> Piled their wax citadel, and stored their honey;
> Hence sallied forth to forage through the fields,
> And swarmed in emigrating myriads hence.

The nest, as constructed by the insects, consists of a continued series of combs arranged vertically, each of which consists of a vast number of cells, forming two ranges, backed against each other, and consequently placed in a horizontal position. A sufficient space is left between each of these double layers of cells to allow a couple of bees, busied upon the opposite cells, to work without incommoding each other. In addition to these spaces, the combs are perforated in various places, so as to allow a passage for the bees from one street to another, thus saving them much time ; but it is in the construction of the cells themselves that the most admirable instinct is displayed. These are formed of wax, a material not secreted in very great quantities by the bees ; whence it is essential that not only the least possible space should be occupied in the nest, but also that the least possible wax should be employed. Geometricians are aware that, in order to occupy a given space with solid objects of equal size and similar form without any useless interstices, three figures only can be adopted, namely, the equilateral triangle, the square or cube, and the regular hexagon. Of these three geometrical figures the hexagon most completely unites, as Dr. Reed observes, the prime requisites for insect architecture. The bees appear, says Reaumur, to have had a problem to solve which would puzzle many a mathematician. " A quantity of matter being given, it is required to form out of it cells, which shall be equal and similar, and of a determinate size, but the largest possible with relation to the quantity of matter employed, whilst they shall occupy the least possible space."

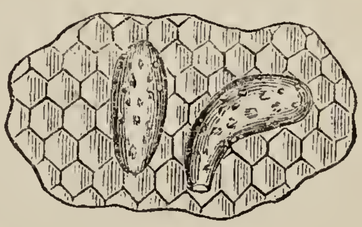
The bottom of each cell is formed of three lozenge-shaped pieces, whence it is obvious that their junction might have been formed at any imaginable angle. Like the slated roofs of houses, it might have been of any inclination. Reaumur, however, suspected that as the bottom of the cells had an uniform inclination, this particular direction was the one which also caused the least expenditure of wax. He therefore asked M. Kœnig, a skilful geometrician, to determine by calculations the following question. Among all the hexagonal tubes with pyramidal bases, composed of three similar and equal rhombs, to determine that which can be constructed with the least possible quantity of matter. Kœnig, ignorant of the object which Reaumur had in view, worked out the problem and found, that if three rhombs or lozenges were so inclined to each other, that the great angles measured 109° 26′ and the little angles 70° 34′, this construction would require the least quantity of matter. Now M. Miraldi had actually previously ascertained by a very accurate admeasurement, that the great angles of the cells were in general 109° 28′, of the smaller ones 70° 32′. Admirable geometricians, which without compasses or figures, not only adopt the most advantageous form for your cells, but build them with that minute precision which insures the employment of the least quantity of materials, and form them of those precise dimensions which will suit the size of the future inhabitant! But there is still another instance of geometrical instinct exhibited in these cells ; a common base serves for two strata of cells, which base is so disposed as to form a pyramidal cavity at the bottom of each, being composed, as above stated, of three distinct lozenge-shaped pieces : hence it follows, that the base of a cell on one side of the comb is formed of portions of the bases of three distinct cells, on the other. By this means, a greater degree of strength and a smaller consumption of materials is obtained, than if each set were first thoroughly formed, and then the two cemented together, whereby each of the cells would have a distinct pyramidal base, or than if the two cells had been a single hexagonal tube, intersected in the middle by a flat instead of a pyramidal division.



Cells shewing manner of uniting at base.

It is a remarkable circumstance, that in a new colony the design of every comb is sketched out and the first rudiments laid by a single bee, which having disengaged itself from the swarm, commences the building of cells, which is then taken up by the other wax makers, and subsequently by the nurse bees, which give the finishing stroke to the cells. And so expeditious are the proceedings of these indefatigable creatures, that a comb, twenty-seven inches long by seven or eight inches wide, is built in four and twenty hours, and in five or six days they will half fill the hive. The combs are attached to the roof and sides of the dwelling, the hives or boxes to the floors and roofs, the cell-work of the combs varnished, &c. with a resinous, very tenacious, and transparent substance, termed propolis, which the bees collect from various trees, as from pines and other trees of the fir tribe, according to some authors, but from the wild poplar, according to Huber.

There are three sorts of cells, the first are for the larvæ of workers and for containing the honey, these are of the ordinary form ; the second are for the grubs of the males or drones,—being considerably larger and more substantial, they usually appear near the bottom of the combs ; the third are the cells for the females, of which there are usually three or four, although Mr. Hunter observed as many as thirteen royal cells in one hive. They are attached commonly to the central part of the comb, having very little wax in their composition, the remainder being considered by Mr. Hunter to be farina. One of these cells considerably exceeds in height the ordinary ones, and they are not interwoven with them but suspended perpendicularly, their sizes being nearly parallel to the mouths of the common cells, several of which are sacrificed to support them : they are of an oblong spheroidal form tapering gradually downward.



Hexagonal Cells with Royal Cells attached.

After the queen bee has quitted her cell, it is destroyed by the workers, and its place occupied by a range of common cells. A beautiful and gradual transition is established between the small-sized ordinary cells and the larger ones, or vice versa, the bases of the connecting cells being composed of two rhombs and two hexagons, instead of three rhombs; the rhombs and hexagons varying in form and relative proportions until the required size is obtained.

Although the general form of the cells is hexagonal that of those first begun is pentagonal, the side next the top of the hive, and by which the comb is attached, being much broader than the rest; whence the comb is more strongly united to the hive than if their cells were of the ordinary shape. It of course follows, that the base of these cells, instead of being formed, like those of the hexagonal cells, of three rhomboids, consists of one rhomboid and two trapeziums.

The bees, observe Messrs. Kirby and Spence, appear to give the proper forms to the bottoms of the cells by means of their antennæ, which extraordinary organs, they seem to employ as directors, by which their other instruments are instructed to execute their very complex work. They do not remove a single particle of wax until the antennæ have explored the surface that is to be sculptured. By the use of these organs which are so flexible and so readily applied to all parts, however delicate, that they can perform the functions of compasses in measuring very minute objects, they can work in the dark, and raise those wonderful combs, the first productions of insects.

The diameters of the cells, intended for the larvæ of the workers, is always two lines and two-thirds, that of those meant for the larvæ of the males or drones three lines and one-third. It appears to be the oviposition of the queen which decides the kind of cells that are to be made, as whilst she lays the eggs of workers, no male cells are constructed, but when she is about to lay the eggs of males, the neuters appear to know it and act accordingly.

The queen deposits her eggs separately in the bottom of each cell; the egg is of a lengthened oval shape, with a slight curve, and of a bluish colour; when laid it is covered with a glutinous matter, which enables it to adhere to the bottom of the cell, where it remains for four days. The workers' eggs, which are the only ones laid by the queen during the first eleven months, hatch in a few days and become little white maggots, which, as they grow, assume a curved position, till the two extremities touch one another and form a ring. Each is now fed with bee-bread by the workers very assiduously, and at the expiration of six days, having attained its full size, it is roofed in by the workers, spins a silken cocoon, which occupies it for thirty-six hours, and then becomes a nymph or pupa; and at the further expiration of eleven days, the insect quits the exuviæ of the pupa, eats through the roof of the cell, and comes forth a perfect worker bee.

The male bee passes three days in the egg state, six and a half in the larvæ, and makes its appearance at the further expiration of fifteen days.

The development of the queen bee requires a more lengthened notice, involving some of the most interesting points in the economy of the hive. We have said that for nearly twelve months the queen bee deposits only workers' eggs, after which period, however, she commences laying those of drones. As soon as this change takes place, the workers begin to construct royal cells, in which, without discontinuing to lay male eggs, she deposits now and then, about once in three days, an egg destined to produce a future queen. This laying of eggs commonly happens in May, lasts thirty days, and regularly on the twentieth or twenty-first day, royal cells are founded. The queens pass three days in the egg state, and five as larvæ; they are then occupied twenty-four hours in forming their cocoons, their cells having been previously closed by the workers. During nearly the whole of the three following days they repose in their cocoons, after which they are transformed to pupæ, in which state they remain between four and five days, appearing in the perfect state on the sixteenth day after the eggs are deposited; thus a worker, or abortive female requires four more days in which to undergo its preparatory state, than the perfect female, whilst four more days are required for the perfection of the male, than for the workers. The cocoon of the queen, however, is incomplete, covering only the head, thorax, and basal segment of the abdomen, a peculiarity probably dependent upon the form of the cell in which she is born, since if a female larvæ be placed in a worker's cell, she will spin a complete cocoon, and if a worker be placed in a royal cell it will form an incomplete cocoon.

The food of the royal grubs has been termed royal jelly. It is a pungent food, prepared by the workers, exclusively for the purpose of feeding such of the grubs as are destined for queens, and is more stimulating than the food given to the common grubs, having a perceptibly acescent taste.

Should it happen, as is sometimes the case, that the queen be killed, or the hive in any other manner deprived of her, during the first eleven months of her existence, and before she has deposited any royal eggs, the most extraordinary circumstances occur. If such an event takes place amongst the wasps, they are said to become restless and idle, wandering away from the nest, and never returning; but with the bees it is far different. For twelve hours little notice is taken of the loss; it appears unknown, and the work of the hive proceeds as usual. Presently a hubbub commences, work is abandoned, the whole hive is in an uproar; every bee traverses the hive at random, with the most evident want of purpose. This state of confusion sometimes continues for several days; then the bees gather in knots, clusters of a dozen or so, as though engaged in consultation, shortly after which a resolution appears to have been taken by the whole population. Some of the workers select one of the worker eggs, which had been previously deposited by the lost sovereign. Three cells are thrown into one for its reception, the eggs in the two other cells being destroyed. The grub, when hatched, is fed with royal jelly above described, and a queen is produced. Even if the grub had been hatched, and partly fed as a worker, and had only received two or three days' allowance of royal food, the result would be the same. They emerge from the pupæ perfect queens, whereas had they remained in the cells which they originally inhabited, they would have turned out workers, having their form, instinct, and organs of generation entirely different.

This is a most extraordinary fact; but if we consider the subject, especially with reference to the worker bees, we must admit that their case is still more extraordinary. Its ordinary occurrence, as is too generally the case, taking off its apparent singularity.

The queen, as we have seen, is a perfect female, the workers imperfect ones. The queen is fed with peculiar food, and comes forth perfect: her food is therefore what we may call naturally perfect food.

But with the workers it is different; for the production of an imperfect animal a peculiar weakened kind of food is given. Here then is the great and extraordinary economy of the hive shown. If every grub were fed with the naturally strengthening food, every bee would be male or female, and perfect; but in such case how would the hive be formed, the honey gathered, the young bees fed? These are the peculiar duties of those bees, which, having no sexual duties to perform, are employed throughout their entire lives in the duties of the hive. Hence, it is far more remarkable that, for the due regulation in the internal arrangements of the hive, the greater portion of the inhabitants should be stinted in their growth, and rendered sterile members of the community, than that a maggot, well supplied with wholesome nutriment, should arrive at that perfect development which is the characteristic of its sex. If the case were reversed—if, for the performance of some singular duty, it were requisite, that in a nest of 20,000 or 30,000 insects, some half a dozen should annually be produced, which should, by the greatest care, be supplied with impoverishing food, so as to become unfruitful, how much more remarkable would the production of the barren bee be considered than it is, because nineteen-twentieths of the community are abortive.

In this light the non-development of the worker bees becomes a new matter for wonder. It may be asked, Can a smaller and more moderately heated house, a less stimulating kind of food, and a horizontal instead of a vertical posture in the larva state, give an insect a differently shaped tongue and mandible, render the surface of its posterior thighs concave and flat, provide them with a fringe of hairs, forming the basket for carrying pollen, furnish them with an apparatus at the extremity of the tibiæ and base of the tarsi, enabling the insects to use their legs as pincers, or furnish them with the pollen brush which lines the inside of their basal tarsal joint? Can they shorten its abdomen, alter its colour and clothing, straighten its sting, furnish it with wax pockets and vessels secreting that substance, and render its ovaries abortive. Can, in the next place, the circumstances above noticed, altogether alter, as Messrs. Kirby and Spence observe, the instinct of these creatures? Can they give to one description of animals address and industry, and to the other astonishing fecundity? Can we conceive them sufficient to change the very passions, tempers, and manners? That the very same fœtus, if fed with more pungent food, shall become a female, passing her time without labour—that this very same fœtus, if fed with more simple food, shall come forth a worker,—this, and more than this, is so contrary to what is known in other branches of natural history, that unless it were perfectly authenticated, we might deem it as fabulous as the stories circulated amongst the ancients respecting the very same insects.

In man and the higher animals it is well known that numerous differences, both as respects the form and relative proportion of parts, occurs frequently, although their causes are difficult of explanation. In many instances these may originate in the difference of the nutriment which the embryo derives in the womb, or from the degree of confinement or temperature caused by that organ; a case that analogically would not be very wide of that of the grub or embryo of the bee inclosed in its cell. These and similar instances which have been adduced, are, however, of rare occurrence, and the result of accident, so that they can scarcely be considered as strictly analogous to the case of the bee.

We are now to suppose that the period of the year is arrived that the queen insects, having undergone the change to the pupa state, are nearly ready to burst forth to life. It is now that the old queen-mother, losing all her parental feelings, becomes infuriated. She rushes to the cells wherein are deposited the future queens, her offspring, and instantly begins to tear them open; the guards which surround the cells make way for her approach, and suffer her to act as she pleases, whereupon she slaughters the inmates with her stings without remorse. As the cells, however, are thicker than those of the workers, she is soon fatigued by her labours; and after she has opened one or two she languidly attempts to gnaw through a third. The sight of these cells agitates her to such a degree that she runs about the hive in a state of delirium. This excitement she soon communicates to the workers by touching their antennæ; and, after scampering about in all directions, a great portion of them, accompanied by their old queen, rush out of the hive, and seek another house. In every instance it is the old queen which leads the first swarm. Experience enables the apiarist to foretell this event, for on the evening previous to swarming the bees suddenly leave off their labours, as if aware of the approaching change, whilst a few scouts are sent out in search of a new colony. Something very like concerted action and foresight are evident in these proceedings. It is always in calm weather, when the sky is serene, between nine in the morning and four in the afternoon, that they quit their habitation. If the female is not found amongst the first which issue forth (in general, however, the swarm drags the mother-queen with them out of the hive), she is not long in repairing after them, and in less than a minute she is followed by all the bees which are to compose the swarm. By degrees they fix themselves upon a branch, form a group there, by hooking themselves one to another with their feet, although they are exposed: they remain quiet, and often, in less than a quarter of an hour, we see scarcely more bees hovering round the swarm than are to be observed around a hive in fine weather. If in sallying forth they fly toward some large tree, there is reason to fear that they may wander beyond the limits of the hive. They are easily brought down by throwing up handfuls of dust. Although the swarm remain tranquil, it must not be left long in this position without offering to it a lodging, especially if the sun be warm, because it would speedily go elsewhere in search of a new habitation. Thus, therefore, in the swarming season, it is necessary to have hives quite ready to make use of as occasion requires. The interior of a hive should be well cleaned before it be presented to the bees, since they are fond of cleanliness. To render it agreeable to them the sides are rubbed with flowers of melissa, bean flowers, &c., of the scent of which they are fond. Some parts of it are also moistened with a slight layer of honey. Thus a fresh hive is established, chiefly consisting of insects lately hatched, which in the course of a very short time commence their labours with all the zeal of the inhabitants of the hive from which they have swarmed. Let us return, however, to the old hive thus bereft of their queen. The bees that remain take particular care of the royal cells, and prevent the young queens successively hatched from leaving them, except at an interval of several days from each departure. This results, in a considerable degree, from the different period at which the royal eggs are deposited. Thus several queens are successively produced, and several swarms thrown off. As soon as a young queen is produced she proceeds instantly to attack the other royal cells; but here there is a remarkable difference in the conduct of the workers, for although they permitted their ancient queen to pursue her own instinct, they by no means extend the same courtesy to her successor; but the moment she attempts to approach a royal cell, the guards surrounding it immediately attack, bite, and drive her off. Irritated at this behaviour the young queen stands upright, and utters a shrill and clear sound; and no sooner is it heard than the bees appear to be paralysed; they remain motionless, and hang down their heads. She then attacks the cells, but in doing so ceases to pipe, when the bees, recovering from their stupor, drive her away. This is continued until the queen is irritated to such a degree that she follows the steps of her predecessor, and in a state of delirium, which is communicated to a portion of the workers, she quits the hive with a second swarm.

In this manner several swarms take place in the course of the summer, between the months of April and August—a necessary consequence of the great increase in the population of the hive, owing to the fecundity of the queen in the spring months far exceeding the loss occasioned to the hive by the cold of winter, which is estimated to destroy six or seven eighths of the inhabitants.

A good stock of bees ordinarily produces three swarms in favourable seasons, and even a swarm of the current year will occasionally throw off another swarm. Five swarms have, indeed, been recorded to have been thrown off; and Bosc, the celebrated entomologist, has stated that, whilst in Carolina, he had eleven swarms in the course of a year from one stock, each of which, during the same season, threw off the same number of secondary ones. Each swarm contains not only young bees recently hatched, but also a portion of the old inhabitants. There are generally from seven to nine days intervening between the first and second swarm; between the second and third the space is shorter; and where there is a fourth, it may depart the day after that which precedes it. Hence it is essential that this space of time should intervene between the flight of the old queen and the appearance in the perfect state of the new one, and this is produced in the following singular manner:—

After the royal cells are covered in, in order that the inclosed grub may undergo its change to the chrysalis state, the workers immediately remove here and there a portion of the wax from the surface, so as to render it unequal; and immediately before the last metamorphosis takes place the walls are so thin that all the motions of the inclosed pupa are distinctly visible. On the seventh day the part covering the head and trunk of the pupa is almost entirely unwaxed, whereby the inclosed insect, on arriving at its winged state, would be enabled to make its exit with perfect facility, were it not for the proceedings of the attendant workers, who are guided therein entirely by the wants of the society. As soon, therefore, as the workers perceive that the young queen has cut circularly through her cocoon, they immediately solder the cleft up with some particles of wax, and so keep her a prisoner against her will. Upon this, as if to complain of such treatment, she emits a distinct humming sound, which excites no dread nor pity in the breasts of her subjects, who detain her two days longer than nature has assigned for her confinement. During this period she sometimes thrusts her tongue through the cleft she has made, drawing it in and out until she is noticed by the workers, who thereupon feed her with honey, till, her hunger being satisfied, she draws her tongue back. At the proper period she is released, and proceeds as her predecessor had done.

Shortly after the swarming has taken place, the impregnation of the queen takes place. Upon this subject such differences of opinion have prevailed amongst naturalists, and such absurd theories have been broached, that, now that the subject has been cleared of all its mystery, the reader cannot but smile at the errors which a minute investigation and an unbiassed mind could not fail to have detected; and thus it has generally been with every question of natural history which required any thing beyond the most commonplace attention. Mankind has been too prone to indulge in the marvellous; and hence, without stopping to inquire into the precise nature of things, well observed effects have been attributed to the most ridiculous causes. Thus it has been with the impregnation of the queen bee; but we will not waste our space, nor the time of our readers, by citing the opinions which have been entertained upon the subject. Similar to the case of the ants, amongst which it is well known that fecundation takes place in the air at the period of swarming, the female bee being preceded by the drones, and having previously reconnoitred the exterior of the hive, rises aloft in the air, wheeling upwards in large circles, until she is out of sight. She returns from her excursion in about half an hour with the most evident marks of impregnation, although occasionally these excursions are of shorter duration, and are repeated, the female, in such case, exhibiting no such marks. Now it is that a new stimulus to exertion is given to the workers; every thing is then done with the greatest care. They hasten to finish the cells which they have commenced, laying new foundations, and appear to be fully conscious of the importance of their activity. The progress of their labours is the signal by which the female is directed in laying her eggs.

According to M. Huber, a single coupling is sufficient to vivify all the eggs which the female shall deposit in the course of a couple of years, and probably for all those which she shall lay during her entire life. According to Huber, the queen ordinarily lays about 12,000 eggs in the months of April and May, which is termed the great laying, as it is from these that the swarms are produced, one of which, of a moderate size, is calculated to consist of from 12,000 to 20,000; hence, as there are several swarms in the course of the summer, it is probable that the calculation of Reaumur, which is double that of Huber, viz. 200 per day, is more correct. Another great laying takes place at the beginning of autumn.

But it is not the queen alone which deposits eggs, since it has been well ascertained that the worker bees occasionally lay them; but it is remarkable that these fertile workers never deposit anything but male eggs. It has been supposed, however, that they must have been small queens (noticed above) mixed with the workers, whose office it was to lay male eggs in old hives. As, however, this is so contrary to the known proceedings of the real queen, it is perhaps to be considered more probable that those fertile insects, which are smaller and more slender than the common workers, may be common workers which have derived their fertility from the circumstance of some royal jelly having been casually dropt into their cells when grubs, as they uniformly issue from cells adjoining those inhabited by grubs that have been raised from the plebeian to the royal rank; of course, therefore, they are never found in any hives which have had the misfortune to lose their queen.

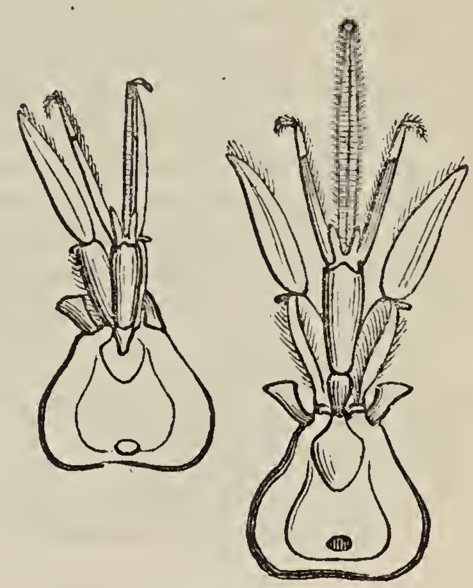
The duration of the life of the different individuals of the hive is various. Without recurring to the fabulous accounts of the old naturalists, who thought that bees lived as long as the hive lasted, were it never so long, it is to be observed, that a male bee's existence is not more than two or three months. The female has been known to live five years, although the general term of her existence is more probably from two to three years; and the workers, from the observations of naturalists, do not appear to be so long-lived as the queen, probably little longer than a year being the term of life.

Thus have we, in a connected form, laid before the reader the " birth, parentage and education, life, character and behaviour" of the honey-bee. The numerous experiments which have been performed upon these insects, although possessing the greatest interest, scarcely seem to fall within the limits of a moderately long article in a work like the present; recourse must therefore be had for them to the Memoirs of M. Huber, to the Introduction to Entomology of Messrs. Kirby and Spence, and to the intelligent volume recently published by Dr. Bevan.

We shall conclude this article by a more detailed account of the structure of the larva and pupa of the bee, and of two organs of the perfect insect, which cannot but be regarded with peculiar interest, namely, the tongue and the sting.

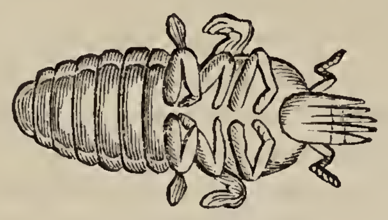
Bee grubs natural size and magnified.

The larva of the bee is a soft fleshy grub, with a wrinkled skin, and is generally to be observed in an arched position in the cell. Swammerdam, who dissected these grubs very minutely, states that they are composed of fourteen annular incisions, including the head; his figures, however, exhibit only thirteen, which number is found in all other insects, one segment being occupied by the head, three by the thorax, and nine by the abdomen of the perfect insect, although in the latter some of the segments of the abdomen of the larva become obsolete, forming, in fact, the organs of generation. The head comprises the eyes, which are transparent and white, resembling the ocelli of other insects, a small transverse upper lip, two small organs placed at the anterior angles of the head, which Swammerdam conceives afterwards become the antennæ, and two " little parts, situated under the former, which seem as if they were articulated and afterwards grow into teeth. Moreover between these two little parts, and consequently under the lip, is presented to view another small and somewhat prominent part, which resembles a trunk or tongue, and this increasing by degrees at length indeed constitutes the trunk of the bee; moreover there is something that hangs out of this little part above like a small nipple, by which the worm discharges its thread to make the web when it has eaten for a sufficient time, and is going to be transformed into a nymph. In some other worms I have seen, besides the tongue, the resemblance of a small and tubular proboscis, situate in the middle, between the tongue and the lip, by the help of which the worm can probably take in its meat. Again, in other such worms, I observed a horny or bony little part immediately under the lip." Their colour, however, which is whitish, prevents their being accurately viewed together.



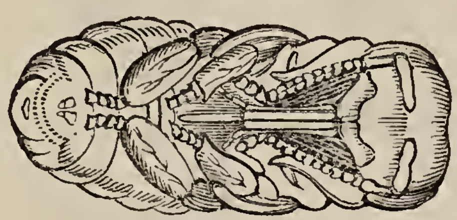
Bee's mouth.

From a careful examination of the structure of the mouth of the grubs of other bees, it appears that the two side organs, or " little parts which seem as if they were articulated," do not correspond with the " teeth" or jaws of the perfect bee, but with the sheaths of the tongue or maxillæ, whilst the former organs are represented in the grub by a pair of horny acute teeth, which Swammerdam has overlooked, if indeed they be not what he has noticed as " a horny or bony little part, immediately under the lip." The body is furnished on each side with ten minute circular spiracles, or breathing pores, a pair being placed on each segment of the body, with the exception of that which immediately follows the head, and the terminal one which bears the anus. The worm being unfurnished with legs, has a very slow motion, and whenever it is disturbed, it merely draws its head and tail, or the posterior part of the body inward; when more roughly handled, however, it sometimes twists and bends itself forwards, and sometimes backwards: but if it be not disturbed it lies in its cell without motion. Although it increases rapidly in bulk, it has not been ascertained that it sheds its skin as the caterpillars of moths do, except when on the point of becoming a nymph, at which period the pulmonary tubes also change their skin and throw out, through the orifices of the body, a thin pellicle. Previous to shedding its skin, the first three segments of the body begin to swell, since it is to these segments that the locomotive organs in the perfect insect are attached. At length the skin of the grub splits along the back, and the skull is divided into three pieces, whereupon the pupa is seen within, which, in a short time, disengages itself from its exuviæ; the organs which a short time previously were but slightly indicated by the swellings on the grub's body, but which, if the skin be stripped off, are nevertheless easily discernible,



Grub stripped of skin.

are now more clearly visible, and indeed may be observed more easily than in the perfect state, since at this period they are not covered with hairs as they are subsequently. The pupa of the bee, in fact, exhibits "an elegant disposition and well-ordered representation of all the limbs and parts of the future bee;" the various organs, however, remain immoveable until the humours are exhaled and dissipated, and hence it is that the bee, whilst in the pupa state, weighs considerably more than in the perfect state. In this state, therefore, we are able to see the eyes, the antennæ, and the tongue lying along the breast, as well as the rudimental wings and the legs, which are extended from the sides of the body along the belly. If all these parts be after-



Pupa.

wards removed out of their places, then the divisions of the head, thorax, and abdomen, appear distinctly, and we may ascertain the manner of the insertion of the legs, which is rendered more difficult in the perfect insect from the great quantity of hairs with which the parts are covered. If the insect be inverted, the three great divisions of the body are equally manifest.

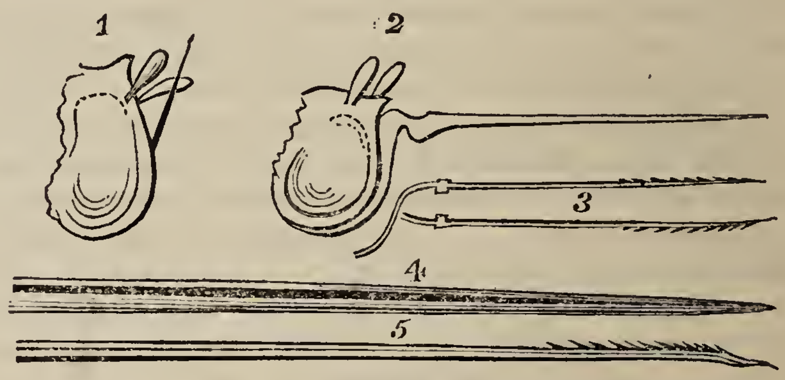
The tongue of a bee, by which is understood the apparatus with which it laps the nectar of flowers, is a very complex instrument, and possesses great powers of motion. As this organ has been very incorrectly described in a modern popular work, we have thought that it might not be without service to describe it in detail. If we hold a bee by its wings, the mouth at first sight appears to consist only of a small transverse lip, and a pair of strong jaws having a lateral motion. (See fig. 1).

Bee's tongue.

On further examination, however, a flattened instrument, of a shining brown colour, is perceived extending from the lip towards the throat—this is the tongue, and at the pleasure of the bee it can be projected forward, either in a straight or a curved form, so as to resemble the beak of a bird, as is shown in figs. 2 and 3. It in reality consists of no less than five distinct branches; 1st, a central piece of very delicate structure, transversely ringed along the greater portion of its length, having a small circular orifice at the extremity; this is the true tongue or lingua, and from the base of this ringed portion arises a pair of feelers, which are scientifically termed the labial palpi, and which are composed of four joints, the basal one being the longest; these organs, when at rest, are defended by a pair of scaly instruments, convex outwardly, and concave inwardly, each of which consists of a basal and terminal portion, articulated near the middle; conjointly, these latter are termed the sheath, and separately the demi-sheath. They correspond with the maxillæ of other insects possessing jaws, and near the middle are furnished with a small lobe-like joint, which is the only rudiment of the maxillary feelers, which in many other bees are very visible, and sometimes six-jointed.

In the third figure the parts are seen from the under side of the head, and one of the demi-sheaths is drawn aside in order to show the manner in which this part protects the tongue, the last joints of the palpi are observed at the extremity of the tongue.

From these figures, and especially from fig. 1 and 3, it will be perceived that when unemployed, the terminal portion of the demi-sheaths, the whole of the labial palpi, and the ringed portion of the tongue, are folded back upon the basal parting of the tongue and demi-sheaths.



Bee's sting.

The *sting* is an instrument scarcely less complex in its structure than the tongue. The whole of its mechanism is exhibited in the above figures. If a bee be held in the fingers, a dart, not finer than the point of the finest needle, is seen to be protruded from the extremity of the body. If this delicate instrument should be plunged into the finger by the infuriated bee, it will in all probability be left there before the bee can disengage itself, and the pain is too well known to need any descriptive comment.

It will be seen, from the above figures, that, like the tongue, the sting is composed of five parts; first, a pair of elongated flattened organs, between which, when unemployed, the extremity of the sting is lodged; second, the instrument itself, which is so frequently seen protruded from the tail of the bee, and which, upon a close examination, is found to consist of a canal having a gutter along its upper edge, within which two darts of the most exquisite construction play backwards and forwards, and which are armed with fine teeth set backwards; the sting, by means of the strong muscles at its base, is thrust forward, as in fig. 2., and, from its strength, forms a support for the interior serrated darts shown at fig. 3, which are plunged still farther into the wound, whence, from their structure, it is impossible to withdraw them without force; the poison, which is conveyed through the canal of the sting, is contained in a reservoir near the dilated base of the apparatus, and is connected with it. The channelled sheath with its serrated weapon are shown on a large scale at figs. 4 and 5; and it will be obvious that its structure admirably fits the possessor to protect the fruits of his laborious industry from any enemy less powerful than man, and even to the "lord of the creation" it becomes an instrument of terror.

BEECH TREE (*Fagus sylvatica*). A tree belonging to the Linnæan class and order *Monœcia Polyandria;* natural order *Amentaceæ*. Generic character: male flower—calyx bell-shaped, five-cleft; corolla none; stamina five to twelve. Female flower—calyx four-cleft; corolla none; styles two or three three-cleft; seeds an angular or three-corner shaped nut, one or two contained in each muricate capsule, which opens with four valves, and emits the nuts. The beech is indigenous to Britain; many extensive natural woods of it are found on the Chiltern Hills and other chalky districts of England. It is a highly ornamental tree; and very much cultivated for its timber, which is of a fine close grain and very durable when converted into Tunbridge-ware, turnery, mill and wheelwrights' machinery, cabinet-makers' articles, &c. It is also used in the dock-yards for wedges; by musical-instrument makers for sounding boards; by coopers for clap-boards. It is very much used in the manufacture of charcoal, and no kind of timber is more used, or better adapted for billet wood. It is also extensively used for sheet-piling of canals, and for round or square piles for the foundations of bridges, or other buildings standing in water, as it is very durable when kept constantly under water.

The tree being very hardy is well calculated for planting in bleak situations where the shelter of woods would be beneficial. It withstands the sea breezes as well as any other; and, though a native forester, is a very suitable tree for park scenery; its fresh green tint in spring, graceful form in summer, smooth silvery bark, and its many rich and mellowed hues of autumn, adds greatly to the beauty of the landscape.

As a rustic fruit tree it is of great value; the fine flavour and fattening qualities of its mast or nuts afford the highest treat to deer and vast droves of swine. To some of the wild inferior animals, both birds and quadrupeds, the nuts are a constant feast; the woodpigeon, jay, and nuthatch, among birds, and the badger, hedgehog, squirrel, rat, and different species of mice, not only live on the mast during autumn, but lay up winter stores of them in their nests and burrows. Even man himself, in some places on the continent, makes the kernels a part of his diet, roasted and used as coffee, and the expressed oil serves instead of butter. This oil is considered next in fineness to the olive, is employed for lamps, and many other useful purposes in the arts, and by mechanists. According to Michaux, "the forests of Eu and Crecy, in the department of the Oise, have yielded, in a single season, 2,000,000 bushels of beech-mast." The oil millers readily buy up whatever quantity of the nuts they can procure; but the lords of manors seldom allow the nuts to be gathered, as their tenants have generally a right of pannage.

The beech tree as well as the hornbeam was formerly much used for hedges in pleasure grounds and gardens as sheltering boundaries; and, being clipped in summer, the remaining leaves die, without falling from the tree till late in the spring On the continent fields are fenced with beech trees. They are planted when young near together, and when grown up five or six feet high are intertwined right and left, and tied together where the stems intersect. In a few years they become engrafted with each other, and then form a very durable fence.

The bark contains a little of the tanning principle, but far inferior to that of the oak. It is also the thinnest of, perhaps, all forest trees; that on a tree of a century old being hardly one quarter of an inch thick. This is the more surprising when we consider that the bark receives an addition of liber in every year of its age. But these annual layers of liber are as thin, and being constructed like fine gauze, are compressed so closely together by the internal growth of the wood, that they occupy but little space. Add to this, that the bark of a beech is not rent into exterior fissures, like that of the oak, to make room for the new layers of wood within, but is stretched horizontally like the lateral spreading of a net, the opened meshes of the cortical tissue being filled up by the parenchymous matter in which the fibrous tissue of all the libers lie imbedded.

With reference to the cultivation, it may be proper to state, that no forest tree is easier raised than the beech. A bed of light loamy earth is prepared, by digging and levelling with the rake; about an inch of the surface is drawn off to each side, the nuts are then spread regularly over the bed, and the earth drawn over again from the sides that the seeds may be covered about an inch deep. This sowing may be done any time between October and February. The bed must be guarded from mice, jays, &c., as well before as for some time after the seedlings appear. These stand on the seed-bed for a year or two; and are then transplanted into nursery rows, to gain strength before removal to their final stations.

Sir John Evelyn, the great founder of beech planting in this country, in describing his process, says, that "for woods the beech must be governed as the oak; in nurseries, as the ash; sowing the mast in autumn, or later, even after January, or rather nearer the spring, to preserve them from vermin. They are likewise to be planted from young seedlings, to be drawn out of the places where the fruitful trees abound." A later author says, "The season for sowing the mast is any time from October to February, only observing to secure the seeds from vermin when early sowed. The sooner they are sown the better, after they are fully ripe."

Besides the common there are several ornamental species or varieties, viz. the purple-leaved, than which no tree is more conspicuous in a pleasure ground, being so great a contrast to the general colour of trees. Of this there is a sub-variety called the Golden Stripe-leaved, which is planted in shrubberies; next there is what is called the Copper-leaved, allied to the purple, and only different in the colour of the foliage. Another from North America is called the Broad-leaved, seemingly a distinct species; as also two others from the same country, viz. the White and Fern-leaved beech trees.

All these are propagated by layers or grafting in this country; and all are admitted into arboretums, or for diversifying ornamental plantations.

Beech Tree.

As the beech kernel is so agreeable to the palate, and perfectly wholesome to the human constitution, it has been suggested whither it be capable, as the hazel has been, of improvement by domestication and culture. If by the art of cross impregnation, or extremely high garden management, the nuts could be advanced to the size of its congener, the sweet chestnut, the result would be of importance to the nut-eating mortals of the south of Europe. Such a result may rationally be expected; and it is one which should not be lost sight of by the fruit cultivator.

BEE-EATER (*Merops*). A genus of *Alcyonian* or *Syndactylous* birds, remarkable for the bright colours and metallic lustre of their plumage, as well as for the nature of their food. They get their English name of "Bee-eaters" because bees form a large portion of their prey, though they also feed upon wasps, hornets, and various other insects of long and comparatively rapid flight. The order or group are called *Alcyonidæ*, from the resemblance they have in their structure and some of their habits to the kingfisher (*Alcedo*); and they are called *Syndactyli* from the structure of their feet, which are the least used in finding their food, and the least efficient for any species of locomotion which are found among the feathered tribes. Syndactylic means "having the toes together;" and these birds have the exterior front toe united to the middle one as far as the second joint, and the inner united to the same as far as the first joint. In the genus under consideration, the hind toe is enlarged at the base, and the claw upon it is very short.

Feet of this description are neither well adapted for walking nor for perching; and few of the birds which have them perch for any other purpose than that of rest, for which the foot is, on account of its stiffness, and the shortness of the tarsus, well adapted. But these feet answer well for another purpose, that of digging in the ground, which is a habit not of this genus only, but of most of the order, in the construction of their nests, which are frequently made as deep as six or seven feet, in steep banks of soft earth.

The generic characters of the bee-eaters are: the feet, as already described; the bill of mean length, triangular at the base, slightly arched, having an elevated ridge on the culmen, sharp pointed, and strong and hard in the tomia or cutting edges; the wings long and pointed, the first quill generally short, and merely supporting the second, which is the longest in the wing; the form of the tail varies with the species, being square at the end in some, forked in others, and in others again with the middle feathers produced, but in all the species it is of considerable length. There is a double hollow anteriorly on each side of the sternum, and the keel of that bone is very much produced, as in all birds of powerful wing.

The plumage upon these birds is not only beautiful in its colours, and rich and metallic in its lustre, but it is remarkably close and firm both in its texture and in its adherence to the skin; so that it is difficult either to deplume or ruffle the birds by any ordinary casualty. Even the skin is much tougher than that of birds generally; and though the flesh, at least of many of the species, is said to be both palatable and wholesome, the birds have to be skinned before they are dressed, in the same manner as such of the omnivorous birds as are eaten.

The nests, as has been said, are placed deep in the ground, so deep as not to be very much affected by changes of atmospheric temperature; and as the birds are day-feeders only, both male and female are in the nest during the night, the one on the eggs and the other between and the entrance, acting as a sort of screen. The temperature of the eggs of these birds during the incubation is consequently much more uniform than that of the eggs of surface or of tree breeders. At the same time, it is a low temperature as compared with the temperature of the atmosphere during the day in the places which these birds inhabit; the greater number of them being found in the hottest parts of the eastern continent, and only one making its appearance in Europe, and that one not found to the north of the forty-eighth parallel of latitude, except as a rare and accidental straggler. The eggs which are deposited in the deep excavations made by these birds are placed, upon only a little moss. They are of a white colour, and vary in number from five to seven.

Eggs so placed, and of such a colour, are not subject to much heat from surrounding objects; and the smooth and glossy plumage of the birds renders them less capable of imparting heat to the eggs than those species which have the clothing on the under part more downy. From these circumstances it naturally follows that the process of hatching should be slower in these birds than in species which have their eggs at or above the surface of the ground. In their incubations, birds appear to work to a certain temperature, and the sitting of the bird seems to be for the keeping up of that temperature when the atmosphere sinks below it. If the nest is on the surface the bird may be said to work to the highest temperature which the place and the season afford, as is the case with the partridge among the clods, or the plover or lapwing on the dry heath. If the nest is elevated above the surface, the bird works to a lower temperature, as in the case of the rook on the top of the tree, or the swift in the crevice of the steeple. If again the bird builds in holes of the earth, especially in holes bored so deep as those of the bee-eaters, the bird works to a temperature still lower than that of the birds which build in lofty situations; but though the general temperature in those hole-building birds is lower than in any other summer breeders, it is much more uniform, and the bird may be said to have less labour in the incubation, very much in the same proportion as it has more in the excavating of the nest. And we find very striking differences in the development of life in the eggs, answering to those differences of what may be called the average temperature of the nesting places. This will be further considered in the article Bird; but still as the genus under notice may be considered as one of the extremes, a short glance at the differences may be useful here, upon the well-known principle that the mention of a law is most effective when accompanied by a practical case which proves its existence.

Now, if we compare the birds which have been mentioned, we shall find that there are striking differences in the rate at which the young are developed, and also in the texture (when matured) of that portion of the structure of birds which appears to require most labour in the development, namely, the feathers. The length of time during which the incubation lasts, until the young break the shell, is not very clearly determined, even in the species to which allusion has been made; but the state of the young birds at that time is satisfactorily known.

The partridge and plover come out of the shell in full activity, and may be said, in part at least, to find their own food in the very same hour. It is true they do not come out of the shell as fliers, neither can they be said to be fledged; but they run very rapidly, and have what may be called an infant clothing of down, which protects them from changes of temperature in their non-age, as completely as they could be protected by feathers.

The rook comes forth of the shell callow and in a helpless state, so that it would perish if it were not fed by the parent bird, and in the early stage if it were not sheltered by that bird during the night. Its feathers are not preceded by a downy coat; but first appear like little tufts issuing from those sheaths in which they are produced. The young rook is accordingly fed by its parents for a considerable time, and does not "branch" or perch apart from the nest for a week or two, neither does it take flight, or in anywise provide for itself until it is fully fledged.

The bee-eaters, and, in common with them, all the order or group to which they belong, and all birds which build in deep holes of the earth generally, are much less matured than even rooks are when they come out of the shell; and they continue still longer in the nest, and are fed there by the parents. Indeed, as compared with young birds which are met with in nests on the surface of the ground, or even above it in trees, and whether the nests be of rude or of compact structure, the young of the hole-building birds, and especially of the bee-eaters, have the appearance of being immature and untimely productions. Their very limbs seem rudimental; and the only part of them that gives evidence of being complete is the mouth, and the rest of the alimentary system. They have no down on them, neither is there any farther appearance of the future feathers, than little dimples at the places whence they are to issue; and to see them in their then naked condition, one ignorant of the appearance of the mature birds, would never suppose that those naked and helpless little things would in time become clothed in nature's very gayest attire, and fearlessly cross the ocean on lusty wing.

When, however, we come to look at the plumages of the three different kinds of birds which we have mentioned, we find a very beautiful confirmation of that general law both of nature and of art, according to which the result is always valuable or elaborate in proportion to the time and the efficient labour bestowed on the preparation of it. The feathers on the partridge and the plover, are downy or loose and spongy; they are also easily ruffled, and subject to be turned and even torn by the wind, while rain soon wets them. They are also in a great measure clothing feathers only, and can bear up the bird merely in short and apparently laborious flight. The feathers of the rook are more compact; and the rook can accordingly take moderately long flights, remain a considerable time in the air, and bear the violence of the weather, at least to a much greater extent than surface building birds can do on the wing. But still the plumage of the rook gets sadly torn when the season is boisterous and it has to range farther than usual for food; and if the rain descends heavily the rook cannot keep the sky, but seeks a perch on the nearest tree, or if there is no tree at hand, it descends and crouches in the shelter if it can find one, or stands huddled together facing the wind if there is none. The bee-eaters have their plumage far more compact than the rook, and also far more firm, both in respect of stiffness and toughness; so that, range where they may, and be the weather what it will, it is not subject either to be ruffled or torn.

Thus the deep burrowing, the low temperature, and the slow incubation and long infancy of the bee-eaters all conduce to a certain purpose,—a purpose which, according to the properties of matter, and the laws according to which nature acts in tempering that matter to the various organs of living creatures, appears to be indispensable for fitting the birds for that office which they perform. It seems that a feather of the best substance cannot be produced hotbed-wise, but must have time, and also uniform temperature, and temperature not too high. It appears that the action of the sun, alternating with the cold of night, would tear asunder the delicate tissue of vessels which is necessary for this firm structure of feather; and therefore the birds avoid them by burrowing in the ground; but in proportion as these feathers are formed under less violent action they require longer time; and then, when they are once matured, they stand in much the same relation to feathers of hasty growth, as steel which has been long beaten on the anvil does to cast iron. They are so tough they cannot easily be broken, and so elastic that they instantly spring back to their position when bent. These properties apply not merely to the shafts of the feathers but to the fibres of their webs; and thus, from the mere consideration of the feathers we might conclude, that in their ordinary habits the birds must have some arduous labour to perform; and we might further conclude that feathers of so elaborate a growth cannot afford to be moulted twice in the year, which last (as well as the first) is confirmed by observation.

We are thus to consider the bee-eaters, which are very numerous in species as well as in individuals, as birds prepared for a very marked office in nature, and it is of use to examine them well in their preparation before we follow them in their course, and watch them in the performances of their labours. We have seen that their bills are, proportional to the size of the birds, sufficiently large for being powerful, but at the same time not heavy; that they are strong in their cutting edges, closing firmly for the whole length, and sharp pointed, so as to divide the atmosphere like an arrow. The wings are long and pointed, not unlike those of the swallow tribe; and the muscles by which they are worked, have ample support, not only from the deep keel of the sternum, but from the furrows in that bone. The tails are long and strong; and the varied shapes of their terminations would lead us to infer three distinct varieties of habits, or rather of haunt among the genus. Thus those with square tails are for ascent or descent, those with the middle feathers produced for more forward flight, and those with the forked tails better able to wheel and turn in the air. Feet to aid in the capture of them, or in the maintaining of their position on the ground or elsewhere when in search of that food, these birds have none, as those organs merely perform in concert with the bill the operation of digging the burrow. Thus, in their feeding, which is the habit that stamps the leading character upon all animals, the bee-eaters are reduced to two instruments only—the wings to bear them to their prey, and the bill wherewithal to seize it Each of these instruments is, however, of so superior a character that it performs its labour most effectively, and the one does not interfere with the other, for the feeding of the bird never interrupts its flight.

As these birds feed by day only, and chiefly when the weather is fine, they are more completely children of the sun than any birds with which we in our northern climates are acquainted.

The colouring of the plumage of birds, unquestionably depends upon the sun, because they are gay and glossy in proportion as they are exposed to the action of that luminary; but the light of the sun must have a substance upon which it can act; and it appears to act most powerfully upon the firm feather which grows slowly, and, in the first instance, under cover. The colouration is an after process, though an obscure one, and one upon which it does not appear easy to get more information; but it has no apparent connexion with the colour of the egg; for the bee-eaters have, in one or other of the species, all the colours of the rainbow, as brilliant as in the rainbow itself, and yet the eggs are white. Whether the bright colours are less sentient to the sun than the more sober hues of the birds of cold climates, we are unable to tell; but the smooth surface, and metallic lustre must reflect the light, as well as decompose it by that refraction which shows the colours; and we find the same kinds of tint and gloss in the day-insects of sunny climes, as in the birds of the same. We may therefore conclude that the splendent plumage of these birds answers as a sort of protection against the ardour of the sun, just in the same manner as the half-furry clothing of the northern owls protects them against the pelting sleet and the driving snow, or as the down upon sea birds protects them against the action of the water.

Thus formed, thus armed, and thus defended, the bee-eaters are sent abroad to restrain the superabundance of those two-winged and membranous-winged (hymenopterous) insects especially, (though their feeding is not confined exclusively to these), which are abroad during the day in warm climates, and of these insects the numbers are immense; and as is the case with all numerous classes in which the principle of life is more than usually active, and which inhabit regions where the elements second and further that activity, they would in a short time usurp the general dominion, if it were not that their restrainers are in proportion to the excess of their energy. If we take the old continent southward of the parallel already stated, which is the limit northward whereof these birds only straggle, and that rarely, we find them increase in numbers as we approach the tropics, and become most numerous in the intertropical latitudes. They are met with throughout Africa, in Asia, south of the central deserts, in New Holland, in the Oriental Archipelago (which seems to be in an especial manner the head-quarters of the more brilliant air-birds), and they range far and wide among the clustered islands, which so beautifully diversify the wide expanse of the Pacific with their verdant surfaces. None of the numerous species is found in any part of the American continent, the analogous place in nature there being supplied by the genus *Prionites*, which resemble the bee-eaters in some respects, but differ very much from them in others. The comparison of these two genera of birds might, if followed out, lead to some important conclusions respecting the tropical parts of the continents themselves; and one of these would probably be found to be that the eastern continent abounds much more in sweet substances than the western, while the forests in the richer parts are less close and tangled. We have corroborative evidence in some of the characteristic mammalia, as in the long-armed apes of the East, and the sloths of the West; and it is not a little remarkable, that there is something like the same kind of analogy between the genus *Merops*, and the genus *Prionites*, as between these two genera of mammalia; the tree-mammalia of the East have long arms, and the air-birds long wings; and both are rapid in their several kinds of motions; the tree-mammalia of the West have short-arms, and the birds which most resemble the bee-eaters have but feeble wings, and both they and the mammalia of the same localities are rather slow in their motions.

The bee-eaters are nowhere birds of the desert, neither do they remain after drought has burned up the vegetation in districts where that is one of the alternations of season. In order that the insects upon which they feed may exist, there must be vegetation, and consequently humidity. Hence it is only by the banks of perennial streams that they can have permanent abodes, or along the margins of the sea in peculiar situations. The great majority of them are, therefore, in so far at least, migratory; but theirs is altogether a different kind of migration from that of the birds with which we are acquainted. The migration which we know, is northward in the summer and southward in the winter, constant to those seasons, and not varying much as to the period of time at which it takes place. It is a migration, generally speaking, in the direction of the meridian, and its extreme limits are the equator and the poles. The migration of the bee-eaters, (and various other tropical birds, participate in it along with them,) is a migration entirely tropical, and does not necessarily follow any general direction, or take place regularly at the same time of the year. It is true that on their northern limits (their only southern limit appears to be the sea), they in so far fall into the general economy of the place as to be seen in the warm season in places considerably north of any where they could be looked for, or even where, considering the nature of their food, they could exist in winter. Thus, for instance, the species which is found in the south, and more especially in the south-east of Europe, does sometimes straggle into the British islands, though its visits are exceedingly rare. It is generally in the county of Norfolk, or Dorset, where they are seen, and those counties are more remarkable perhaps than any other in England, for the appearance of rare birds. There a flock of as many as twenty has been seen at once, about June, and again (though of course the identity of the birds was presumed, not proved) in October; but where or how they spent the interval is unknown.

But these occasional migrations northward in summer, taking place as they do upon the mere confines of the proper locality of the genus, are to be considered as anomalies rather than as any part of the general habits of the birds. Where they are "at home," so to express it, their migrations are regulated entirely by the alternations of the tropical seasons, that is, of the rains and the drought; and as these depend in a great measure upon situation, it sometimes happens that at the same time of the year, the bee-eaters shall be arriving at the one of two places, and departing from the other, though both places are situated under exactly the same parallel of latitude. Thus it sometimes happens, that in those parts of peninsular India, where the one coast receives only the rain of the south-western monsoon, and the other coast that of the north-eastern, the bee-eaters migrate on the parallel of latitude from the one side of the peninsula to the other.

In the Oriental Archipelago, migration is, upon the whole, less necessary to them, because, for reasons in part explained in the article Atmosphere, many portions of the surface there, are perpetually verdant. Bee-eaters, as well as other species of birds, do, however, migrate from those favoured isles; but they may be said to do so rather for the purpose of gathering in an abundant harvest in other places, and again returning when the pastures which they visit are bare, than from any absolute want of food in their island homes. Many parts of New Holland are totally destitute both of insects and their food for a portion of the year, though they produce these abundantly at other times. This is more especially the case in the north-eastern or most tropical part of that vast island. There there are extensive districts, which, when the rains fall, are laid under water; and as this water evaporates by the action of the sun, a rich vegetation springs up, and then there are insects in myriads. At that season there is food for many bee-eaters; and where food is abundant nature always provides a corresponding abundance of feeders. When, however, the action of the heat, which is there very intense, and as the bottom of the sea reflects heat and light, the sea-breeze does not tend to fertilise even the shore, beyond the mangroves which grow in the water, the earth soon becomes burnt up, and there is no insect food, except for the species which inhabit the few hard-leaved trees that can endure such a climate, and these are not the proper food of bee-eaters. Of course there is an arrival and a departure of the birds annually in that country, and in all countries in which the seasons are similar.

In places where, though the plains are burnt up, the rivers do not run wholly dry, the seasonal movements of the birds are confined to the country itself. Thus, in southern Africa, where the *karroos* are rich with leaves, gay with flowers, and abundant in honey, which they always are in the fertile season, the bee-eaters find ample supplies of food over them; but when the karroos are burnt up, the birds must betake themselves to those places along the banks of the rivers where vegetation is still vigorous, and food is to be found; and all places which have their seasons analogous to those of southern Africa, whether they take place at the same time of the year or not, must subject the bee-eaters to similar migrations.

From these few hints some knowledge of the general haunts of the genus may be inferred; and, as is the case with all birds, they may be presumed to breed at that place and time of their range where food is most abundant, and the succession of it of longest continuance.

These migrations give the birds much exercise for their powerful wings, but these are also in constant exercise while they are feeding. Thus, if we except the swallow tribe, we have no birds in temperate climates which find their living by such severe and continuous labour as the bee-eaters. Many of the birds of prey have, no doubt, harder work while they are engaged in it; but then the capture of an individual furnishes the greater number with a hearty meal; and the smaller hawks, which occasionally feed on beetles, catch these right and left with their claws as they are flying. But the bee-eaters have no auxiliary to the bill; they have not the *vibrissæ* to it like the goat-suckers; they do not appear to have any glutinous secretion in the mouth; and the probability is that they do not, like many insect-feeding birds, fly with the mouth open when they are feeding. They capture their prey with a snap of the bill, as the swallows do; but as the food of the swallow is generally stingless, and many of the species on which bee-eaters feed have stings so powerful and so much envenomed, that it would not be very pleasant for the birds to take them alive into the mouth. Any one who has had the mischance to shut his lips on a live wasp can tell how awkward a matter it would be to attempt subsistence by swallowing these creatures alive. It is thus to be presumed that the bee-eaters invariably kill their prey by the snap of the bill, that is, by bruising it between the tomia the instant it is touched.

This renders their hunting (or hawking, if the word is more appropriate) a matter of course. Those insectivorous birds which hawk sightless, or at random, as one may say, must receive the insect in any way and in any part of the open gape to which the current, produced by the flight of the bird, happens to direct it. But the bee-eaters, and probably also the swallow tribe, must follow their prey by sight. The vision of swallows, and especially that of swifts, is known to be exceedingly delicate, especially as regards length of distance at which a minute object may be seen. But is probable that the power, especially the near-sight, or microscopic power of the bee-eaters, is much greater, because they have to seize the insect in a particular manner, which is not necessary in the others; and if we suppose a bird careering at the rate of fifty miles an hour, or probably of more, seeing a bee at the distance of probably a hundred yards, and coming up with it with such certain aim as to snap it instantly between the cutting edges of its mandibles, we may easily perceive how wonderful must be the power both of vision and of flight in the bird.

No human ingenuity could perform such an exploit, even though we leave the prehensile or snapping part of it out of the question, and that is the nicest of the whole. The arrow of Robin Hood or William Tell, or the bullet of the surest marksman that ever drew the trigger of a rifle in the back-woods of America, would have been, or be, altogether unequal to such a feat; and when we consider that the all-flexible atmosphere is the bow from which the arrowy bird shoots itself, our wonder may well be increased. There is, of course, leeward motion both in the bird and the insect, varying with the strength and direction of the wind, and also of the different specific gravities of the pursuer and the pursued, and the different rates of their motion. When the wind is beyond a certain strength, neither the one nor the other can "take it sideways;" but bees do fly, and bee-eaters capture them during light breezes, though, as we find swifts most assiduous in their lofty hawkings in that tranquil state of the atmosphere which immediately precedes rain, we may conclude that such weather must also afford most successful sport to the bee-eater.

But even granting that the air is perfectly still, except in so far as the forward rush of the bird produces a current—the capture is a very nice, and to our knowledge of mechanics, apparently an impossible operation. The pointed wings, the produced feathers in the tail, the lightness of the feet, the smoothness of the plumage, and the muscular quickness of the bird, together with the obedience of the whole to the eye which guides it to its object, work beautifully in concert; and when we consider what the bird has to perform, we may well cease to wonder both at the superiority of its organs of aërial motion, and the great length of time, compared with that of mere ground birds, which is spent in elaborating and perfecting them.

The space to which this article must necessarily be restricted, prevents us from following out this remarkable instance of the beauty and perfection of animal mechanics as it ought to be followed; but we trust that enough has been said to arouse the attention of the reader to a subject, than which there are few more worthy of being studied. The forms and colours of birds force themselves upon our notice by their gracefulness and by their beauty; and we may rest assured that nature never entices us to our disappointment, but that whenever she is more than usually attractive, the lesson which she has to teach us is certain to be, when fully studied, more than usually instructive. Fine as is the organisation of these birds, and perfect as are their movements, they are still wholly made of matter, and moved by such means as matter can be moved by; and therefore though their action involves a degree of mechanical perfection which we can never hope to equal, or ever nearly approximate, yet still it is mechanical action, and we may learn much by studying the bird as a model.

The details of species in this highly interesting genus form a department of study sadly different from the contemplation of the general structure and the habits. The real species, or those which possess all the generic characters, are numerous; and different describers have added to the perplexity by mentioning as bee-eaters, birds which may with more propriety be included in other genera; besides, other than mere size, colour, and locality, the specific distinctions are few, or, strictly speaking, none; for, though the different terminations of the tails would lead us to suppose that there are differences both in place of abode and in manner of flight, yet these differences are not established by observed facts; and though it be true of some other birds that those with square tails are most expert at ascending or descending in their flight; that those which have the external feathers of the tail much produced, can wheel in the air by turning upon them as pivots; and that those which have the middle few thus produced, so that the tail is wedge-shaped, are the steadiest upon a line in forward flight; yet these act in accordance with the general structure of the bird, so that we cannot implicitly rely upon the analogy in any other. But yet further to perplex us in the details of this genus, the habits of the birds are such that in wild nature the sights of them are but momentary. They are in the air, driving about like fine brands, or pieces of rainbows, according to their colour; and they will not perch and occupy themselves so situated till we can minutely examine them. Hence, not a few of the recorded species are no further known than the museum specimens; and thus, though there is no question that they exist and exist plentifully in nature, yet all that we know of their history may be learned by simply looking at them. There is, however, one slight advantage in the specific arrangement of these birds, an advantage in which all the birds of warm climates, which have rich and boldly contrasted colours, may be said to participate. It is this: their glossy plumage and gay colours are subject to much less variety either in different individuals of the same species, or at different ages, than in birds which are less gorgeous in their attire. The young come forth in mature plumage; and when they moult afterwards, the process appears to be so gradual, that there is little difference arising from season. Both of these might be expected; the preparation of the first plumage seems too laborious a process for being expended upon that which is soon to be replaced by a different one; and the necessity of these birds to be on the wing when they feed, renders it indispensable that they should be at all times in flying order. Even if they belong to those latitudes in which we could presume a short period when little food is required, still that is not the time at which birds moult; and in the latitudes which these birds inhabit, there is not even an approximation to any thing like hybernating on the part of any of the feathered tribes.

From the number of the species, the little that is known of many of them, the similarity of their habits, and the length at which the chief of these have been noticed, we shall give little more than a list of those which are most interesting, beginning with the European species.

Common Bee-eater (*Merops apiaster*). This is a very beautiful species, and certainly one of the finest of all the rare and local birds of Europe. It is about eleven inches in length, but the female, as is the case in most species of the genus, is rather smaller than the male. The extent of the expanded wings is about seventeen or eighteen. The colour on the upper part is of a maroon red, fading into yellowish rust-colour on the middle of the back; the front of the head white, shaded with green; the eye-streak large and of a black colour; the quills and coverts olive green; the neck golden yellow, marked in the middle with a half collar of black; and all the rest of the under part clear aqua-marine, or sea green. The bill black, and the feet brown. These are the colours of the male bird. In the female, the tints, where they resemble those in the male, are duller; she has a yellowish band underneath the eyes, and the breast shaded with reddish. In the young, the upper part is greenish brown; they have a reddish streak under the eyes, and are without the collar which marks the mature bird. The coverts are in them also nearly all of the same length, while in the old birds the middle ones are longer than the rest.

These birds are very rare in western Europe, as the southern parts of it are too dry for their habits; but, during the summer, they are by no means scarce in the south-east, and they range as far northward as the Don and the Volga, the steep and soft banks of which are drilled as thick with their holes as some banks with us are with the holes of sand martins. They are also abundant on the Lower Danube and the larger branches of that river—much more so, indeed, than nearer the Mediterranean, where the weather is more unsettled in the summer, and therefore not so well adapted to their habits. But though they do not take up a regular abode westward of the centre of Russia, northward of the Carpathian mountains, or generally much higher on the Danube than Hungary, they sometimes pay straggling visits to other parts of Europe, as has been mentioned in the case of those seen in Norfolk. Beyond the limits which we have stated they are, however, to be considered as mere stragglers, and the appearance of them in any place one year is no ground for even presuming that they will be found in that place the year following.

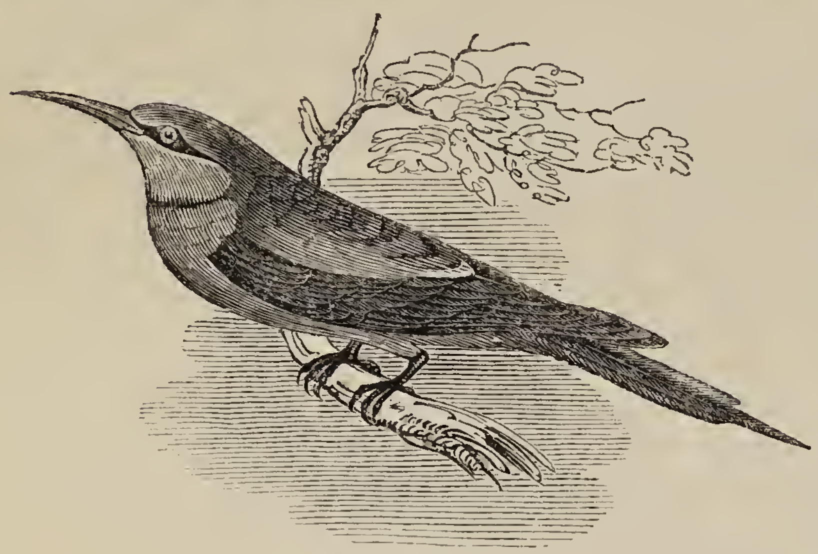
In all places of Europe they are to be considered merely as summer migrants, and as migrants in longitude more than migrants in latitude. They range from east to west, or rather from south-east to north-west, along the great internal basin, which may be said to extend from the Hindû Koosh to the Carpathian mountains, and only partially interrupted by the ridges of Caucasus. It is also probable that from the Oxus, which rises in the Hindû Koosh, and discharges itself into the sea of Aral in a direction nearly the opposite of that by which the Volga descends to the Caspian, they may pass the gorges of these mountains, and descend the Indus and the other rivers of India, upon the banks of which it is probable that many of them winter. They cannot winter in the country south-eastward of the Caspian, because though that country is very hot in summer, as is the case with the south and even with the north of Russia, it is cold in winter, the rivers being sometimes completely frozen over as far to the southward as Bokhara, where of course bee-eaters could not find food. The migration of birds along this basin is not confined to bee-eaters, but applies to many of the most interesting of the rarer insectivorous and aquatic birds which are found in eastern Europe in the summer, but quit that part ere the winter sets in. The pratincole and several of the herons belong to this migration, and some of them occasionally straggle into western Europe, as well as the bee does. The subject is, however, too extensive and too intimately connected with the general economy of nature in the wide region to which it refers, for being advantageously noticed while discussing the habits of a single species of bird.

This is the species which has been longest known, and the one to which the name of *merops* was first given, probably on account of the black streak or division across the eye. The habits of the bird were, however, much misrepresented by the ancients, who made it the type of filial affection, asserting that the young birds fed the mother while she remained at her ease in the security of the nest. There is no bird, and indeed, so far as is known, no animal which has that habit; and it would be contrary to the general rule of mere animal nature if they had. The old animal feeds and rears the young ones; and when it can feed and rear no more, its use in the economy of nature may be said to be at an end, and it speedily dies. This general rule is not departed from in the case of the bee-eater, for the old birds of these have to feed their young for a longer period than almost any other species.

The common bee-eater is also the only one which may be said to have a northern history, as the others have been met with chiefly at the other extremity of what may be considered the zone of their inhabiting.

The common bee-eater is so abundant in all the islands of the Archipelago and the Levant as to be one of the most common summer birds. The climate of those islands is very fine; and as, from their comparatively small size, no part of them is at any great distance from water, they abound with insects, which afford subsistence to all the species of insectivorous birds, especially those which prey on the wing

In these islands the species under consideration is as plentiful and as familiar in his habits as swallows are with us, only it builds, or rather burrows, in banks remote from human habitations. But, in search of its food, it flies in the close vicinity of houses; and, in Crete especially, the boys are said to angle for it in rather a curious manner. They catch locusts, or any of the larger winged insects, which have considerable power of flight; fasten the insect to a crooked pin or small fish-hook at the end of a line; and, letting the insect fly from the window, retain the line in their hand. The insect mounts up and endeavours to escape, notwithstanding the weight which it has to drag after it; and the bee-eater perceiving it in the air, snaps at it, is caught by the hook, and dragged home. This is perhaps one of the most singular modes of bird-catching, and yet anglers in this country sometimes catch swallows involuntarily, in a manner nearly similar, by means of their artificial flies; and the writer of this article has sometimes been astonished in casting his fly, at throwing a swallow on the water, instead of raising a trout. The swallow in this case no doubt catches the artificial fly while in motion through the air behind the angler; which in part proves, by the way, that swallows do not catch flies knowing them to be flies, any more than fish do, but that they merely pursue that which they see in motion. Water birds often do the same thing, especially with the larger kinds of flies; and it is not impossible to catch one of those birds while trying for a salmon. Indeed it appears that most animals which capture prey when it is in motion follow it just because it is moving; for boys sometimes catch the common bat by means of the heads of burdock, dipped in powdered whiting to render them more conspicuous. The hooks of these substances grapple the flying membrane of the bat, and thereby destroying its balance, by making one side heavier than the other, bring it to the ground. These circumstances, especially those of the bee-eater and the swallow, show how very slight a resistance can make even a bird of powerful flight lose command of itself when on the wing; and the consideration of them may well heighten our admiration of that dexterity with which birds, as they fly along, avoid, and that apparently without an effort, those numerous obstacles which are in their way.



Merops apiaster.

Merops Castaneus of some authors. This name has been given to two distinct species or varieties, or the one species has been found in two places pretty far distant from each other, and varying considerably in size.

One of these is named "Adanson's bee-eater," and is found on the Senegal and Gambia, in Western Africa. It is said to be sixteen inches long; to have the bill black, and the head red. The upper part of the body reddish-brown; the under part, the rump, and the lesser coverts, sea-green; the throat, the sides of the neck, and the breast, bright blue green; the quills green; the upper coverts of the wings blue, and the under ones ash-colour: the two middle feathers of the upper coverts being two inches longer than the others, and having their tips black.

The other has been described as the "Mauritius bee-eater," and is found in that island. It is much smaller than the former, being only eleven inches in length. Its colours are described as being almost exactly the same.

Many of the African species are of much smaller dimensions. Among these are the

Angola Bee-eater (*Merops Angolensis*), which, as its name implies, is found in Angola. Its length is about five inches and a half. Its colours are, golden-green on the upper part, and sea-green on the under. The neck and throat rich reddish-brown; eye-streak ash-colour, dotted with black; quills and coverts green on the upper side, and ash-colour on the under; the bill ash-colour, and the feet black.

Two-coloured Bee-eater (*Merops bicolor*). About the same size as the preceding; having the upper part reddish-ash, and the under part red. The eye-streak brown, the cheeks and sides of the head pure white; the wing-coverts black; the quills blackish-brown on the upper sides, and ash-coloured on the under. The bill and feet black.

Bullock's Bee-eater (*Merops Bullockii*), of which a figure is annexed, is also about the same size. The upper part is green mixed with fawn colour, in clouds or spots; and the under part brown. The crown of the head blue; the nape of the neck fawn-colour; the eye-streak black, and very conspicuous. The neck red; and the belly and under tail-coverts blue. The bill and feet black.

There are ten or a dozen other species, nearly of the same size, but differing considerably in their colours and marking, described as inhabiting different parts of Africa and the larger African islands; but it does not appear that they have any peculiarities of character which can render them interesting as subjects for popular description.

The physical circumstances of Africa make it peculiarly favourable for these birds, and indeed for all birds which have the power and the habit of ranging to considerable distances in search of their food, so as that when it fails in one place they can seek after it in another. Countries in which the rivers flow among mountainous ridges and with rapid courses, so as not to flood their banks, do not suit these bank-inhabiting birds. Their favourite localities are in those places where the floods, during the rains, fill the entire channel, and back water stands in pools behind those natural dykes which such rivers generally form for themselves. The mud on the banks and in the bottoms of those hollows where the water stagnates is just the proper nidus for very many species of insects; and when it becomes hot during the warm season, and approaches to dryness, it becomes literally alive with larvæ, which are very speedily on the wing. The same heat, too, and the same moisture upon which that heat acts, call up, in very brief space, an exuberant vegetation, which is in full flower in shorter time than is required by the lagging vegetation of our moderately-working climate to cover the clods. Thus as the dry season sets in, in such situations, a plenteous supply of insect food and insects, both of the kinds which gnaw the leaf and which suck nectar from the flower, is produced so rapidly, that to us, who are accustomed to watch the slow progress of the season for months, it would appear like magic. To-day the surface is a lake; one week passes, and it is sludgy mud, heaving with the motions of millions of living things; another week, and it is a flowery meadow, the air over which is literally cumbered with little wings. It is then high feasting-time with the insectivorous birds; and so rich is this feast on the banks of the African rivers, that all the migrant tribes which make Europe lively with their activity, and joyant with their songs during the summer, congregate to partake of it. The swallow from our chimneys, the martin from our sand-banks, the swift from our towers, the cuckoo from our thickets, the nightingale from our groves, and many others, turn their wings on the southern shores of England, and then onward with rapid flight to the Senegal, the Gambia, the Niger, or the Congo, there to wanton under an ardent sun, and fare sumptuously upon the fruits of an all-teeming earth, while with us the bud is wrapped up in its winter tunics, and the insect is in an egg so small and so well-concealed that it eludes the microscopic ken of the titmouse. There they meet with birds of southern Africa and of western Asia, all intent in the following of their own instincts, and all at peace with each other; and while the rays of the sun, striking perpendicularly downward, heat the earth like an oven, the air, which might else breed putridity and death upon the surface, is literally winnowed into healthy motion by the operation of wings.

All the great rivers of Africa, with the exception perhaps of the Congo, have this character. The places where they rise, or at least where they assume the majesty of rivers, are not very elevated, and therefore their currents are slow; and what they take from the uplands in which their feeders rise is not borne onward to the sea, as is the case in such turbulent floods as the Mississippi and the St. Lawrence, but deposited in fertilising mud along all the meadows on their banks; and, while those floods bring soil they bring vegetation, and also the smaller kinds of life. We have seen that the birds come to perform their portion in this work of exuberant activity; and the antelopes (see ANTELOPE) bound forward to browse the lighter vegetation, while the elephant, the rhinoceros, and the hippopotamus, are also welcome, and well-served guests at nature's universal table.

During this season, when there is plenty, and plenty unknown almost in any other clime, by the banks of the rivers, the plains are gradually becoming dry and scorched. There ceases to be food even for a bee in situations where, only a few weeks before, there was abundance, and consequently the bee-eaters betake themselves to the margins of the streams, and there remain while the dry weather lasts; but the excessive action of nature exhausts the humidity of the soil by a threefold waste: one part of it is evaporated, spreads in the air, and forms dew upon the margin of the desert, so as to preserve for a time there that hard and scattered vegetation which is the food of the antelope and of some other mammalia; another part of it is taken up by the action of living vegetables; and a third portion goes for drink to the animated tribes, from the mite upward to the elephant. This rapid action, in many instances, exhausts and withers the surface almost to the river's brink, before the turn of the season comes; but in the more favoured situations, the pause in nature arising from this cause is brief, and the second flood comes while something yet remains of the abundance of the first

As that flood swells, and the birds would be driven from their holes in the banks by the rising waters, the uplands, erewhile sterile by the drought, enjoy the rain, and profit by it for some time before it causes any alteration in the river; so that, by the time the birds are driven from the one locality, the other locality is prepared for their reception and maintenance. The same agent which forces them from the one place fits the other place for receiving them: that agent is the rain, distributed in its season by those periodical movements of the air, a short account of which will be found in the article ATMOSPHERE.

The bee-eaters form only one part of this great seasonal action in Africa; but they form a beautiful and interesting part, and their movements cannot be well understood, or their uses in nature appreciated, without some such allusions as those which have been made. In their other localities, as in India and the Oriental Isles, they are not quite so characteristic of the succession of seasons, neither are they so much so in the narrow part of Africa, southerly toward the Cape of Good Hope, as in the middle latitudes, where the continent is broader. The seasonal action there is chiefly between the sea and the land, and in great part between the one hemisphere and the other; whereas, in central and northern Africa, the action is chiefly between the thirsty desert and the fertile plains along the rivers. Therefore, all the birds and other animals which resort to Africa by migration, or migrate seasonally from one part of it to another, have an African history somewhat different from that which even the same species have in other parts of the world.

There are still some African species, which we may notice on account of the beauty of their colours.

RED-HEADED BEE-EATER (*Merops ruficapillus*). This species is about eleven inches long, and eighteen in the expanse of the wings. Its colours are: the upper part bright green, with metallic lustre; the under part greenish yellow, glossed with rose-coloured reflections; the head maroon red, with green reflections, which colour also extends in part over the nape; the eye-streak black, a portion over the eyes white, and the throat bright yellow. This species, which, from the measurement stated, is of considerable size, is one of the most beautiful of birds. Its colours are equally remarkable for the purity with which they show an entire tint in some directions of the light, and for the contrasts which different positions of the light bring out. It is also very compact and handsome in its form. The colours of the female are not so bright as those of the male, and the size is rather inferior.

TARVA BEE-EATER (*Merops hirundinaceus*). This species gets its trivial name from flying rather higher, and having more the habits of a swallow than many of the genus. It is by no means rare in southern Africa, and is the species which is there known as the "gnat-snapper," though that name is given to bee-eaters generally by the colonists at the Cape. This species is of a clear yellowish green on the upper part, and pure green on the under; the throat yellow, with a blue collar; the rump and wing coverts blue; the eye-streak, the bill, and the feet, black; the tail is very long, and much forked; and the bird wheels about in the air much in the manner of the swallows.

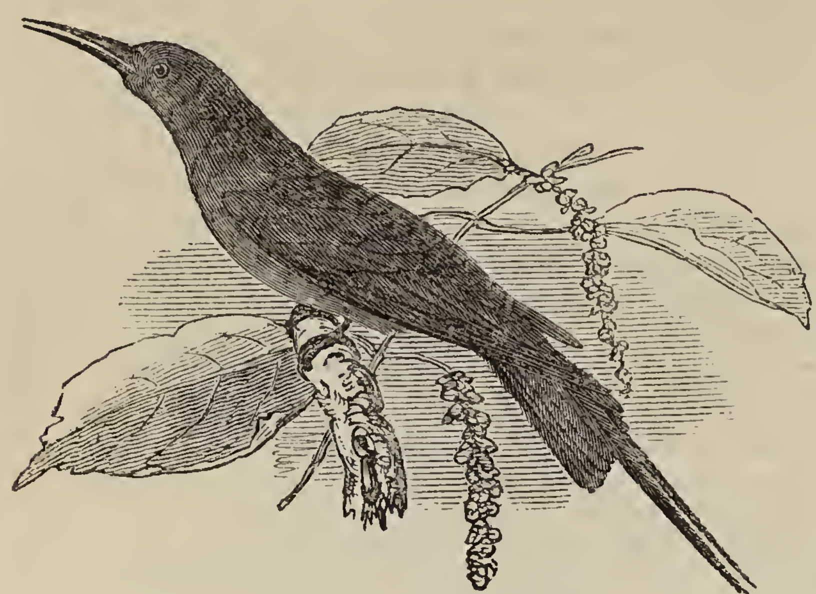
THE EYE-BROWED BEE-EATER (*Merops superciliosus*) is an inhabitant of Madagascar, and about eleven inches in length. The upper part is dull green, but brighter towards the rump. There is a large streak of black proceeding from the base of the bill over the eye to the throat, where the streaks unite and form a gorget of maroon brown, the throat being pale yellow, and the border of the streak greenish white. The top of the head is brown, with reflections of very brilliant green. The quills are green; the covert green, margined with brown and tipped with black; the bill is black, and the feet brown. This is also a very beautiful species.

We shall now notice one or two of the species which are described as being natives of the Asiatic isles.

FIVE-COLOURED BEE-EATER (*Merops quinticolor*. This species inhabits the Spice islands. It is about eight inches in length, bright maroon brown on the upper part, and blue mottled with yellow on the under; the scapulars and coverts are bright green; the rump and part of the quills blue; the throat yellow, with a black collar; the bill black, and the feet yellow.

GREEN-COLLARED BEE-EATER (*Merops viridis torquata*). This is an Indian species, about eleven inches in length. It is green on the upper part, but clouded with ash colour, and greenish white on the under; the forehead sea-green; the throat pale yellow; the upper coverts green, bordered with brown; the under coverts paler; the bill and feet black.

SUMATRAN BEE-EATER (*Merops Sumatranus*), of which the following is a reprentation, has the head and upper part of the neck rich brown; the throat, rump, and tail coverts, bright blue; the breast and wing coverts green; and the quills, tail feathers, and bill, black. It is a native of Sumatra.



Merops Sumatranus.

There are many other Asiatic species, but as nothing is known of them beyond the museum descriptions, a transcript of these could afford no information, and consequently give no pleasure to the general reader.

BEETLE. The English name used to designate insects belonging to the order coleoptera. In general it has reference to those particular species which are of obscure colours and found in dark or damp situations; but the term is by no means exclusively employed for coleopterous insects, since the black beetle, or, as it is more specifically, but not more elegantly, termed the cockroach, belongs to another order, namely, the orthoptera, distinguished at once from the coleoptera, by having the wing-cases of a less firm consistence, and not meeting along the back in a straight line. If it be deemed advisable to employ English names to designate the orders and genera of insects, and indeed any other of the less known groups of animals, it must be admitted that the English names ought to be as restrictedly employed as the scientific ones in the stead of which they are used; hence, the term beetle ought to be confined to coleopterous insects alone.

These animals are exceedingly numerous; and though there is a sort of general character which runs through the whole, in consequence of which they cannot be mistaken for or confounded with any other tribe, they vary very much in the details; and the forms of some of them are exceedingly curious. The greater number of them are a very sturdy race in proportion to their size; and in the perfection and strength of their horny covering, not only in the cases of the wings but upon the body and limbs generally, they are among the most perfect instances of that peculiar kind of strength and action which characterises the articulated animals. See Articulata.

Though the greater number of beetles, even of those which inhabit the waters, can fly, yet flight is with most of them rather the means of change of place than of the immediate search of their food; and even the aquatic ones are chiefly breathers of air rather than breathers of water; but as insects do not breathe by the mouth, but by stemmata, or spiracles, which are often on the abdomen, the water-beetles do not raise the head above the water in breathing, as is the case with aquatic mammalia, they elevate the opposite part of their bodies, as may be seen in the case of the dytisei, or plunger beetles.

Generally speaking, they are obscure animals, living in the earth, or otherwise in concealment, for the greater part of their lives. They are mostly very voracious both in the larva and the perfect state; and, though there are exceptions, their general function in nature appears to be that of scavengers. They consume indiscriminately in the different species, all manner of substances, animal or vegetable, which would otherwise be wasted; though there are several species which prey directly upon living animals, and others upon living plants.

The quantity of substances that they consume, which would otherwise become offensive, might appear almost incredible to those who do not consider their numbers and their activity; and, though none of them are very large animals, perhaps there is no race more useful in the economy of nature than the beetles, especially in warm climates, where the action of life and also of putridity are peculiarly strong.

They are also great favourites with those who form collections. Their forms are not, in general, handsome, according to the commonly received notions; but their colours are, in many of the species, the most splendid that are met with in nature, on account of the richness of their tints, the brilliance of their metallic lustre, and the iridescence of their varying hues as the light falls differently upon them. In consequence of the firmness of their covering they also alter less in the dead state, either by shrivelling, or by the fading off of their tints, than almost any other animals; so that a collection of the bodies of dead beetles, comes nearer in appearance to a collection of living ones than is the case in almost any other animals, the shells of the mollusca not excepted, as the tints of these when living are often in the epidermis.

Of animals which are so numerous there are of course many subdivisions, which cannot conveniently be explained under the English name beetle. Therefore it will be more convenient to refer them to the general article Coleoptera, and the subordinate ones which are referred to from that.

BEGONIACEÆ. A natural order of dicotyledonous plants, allied to the Polygoneæ, containing one genus and about forty species. The characters of the order are: flowers unisexual; tube of the coloured calyx adnate with the ovary, limb of the calyx, in the sterile flowers, consisting of four species, in the fertile of five; stamens distinct or united into a solid column; anthers collected into a head, two-celled; ovary winged, three-celled; stigmas three, two-lobed, sessile, somewhat spiral; fruit capsular, winged, three-celled, with numerous minute seeds.

The plants of this order are herbaceous or shrubby, furnished, like the Polygoneæ, with an acid juice, and having pink or white flowers growing in cymes. They are common in the East and West Indies and in the warmer parts of South America. No species are met with on the African continent, although some exist in Madagascar and the Isles of France and Bourbon.

The Begoniaceæ require considerable heat and humidity, and are easily propagated by seeds or cuttings. Few of them are used either in an economical or medicinal point of view, being chiefly prized as ornamental plants. They yield an acid juice as has been already stated, and their roots are bitter and astringent.

The only genus is Begonia, whence the name of the order is derived. Many of the species are cultivated on account of the neatness of the foliage, and the showy nature of their flowers. The silver-spotted and two-coloured Begonia are the most beautiful species.

Bicolour Begonia.

The genus is remarkable for the peculiar obliquity of the two sides of its leaves, which, in the Begonia bicolor, resembles the ramifications of the blood vessels in the human frame.

Begonia grandiflora and *tomentosa* are mentioned by Decandolle as being used in Peru, on account of their astringency, in fluxes of blood and diseases of the chest.

BELEMNITES. A fossil found in great abundance in most of the formations from the lias upwards. The origin of these singular productions has at all times been involved in great obscurity, as nothing analogous to them in form has been observed among living animals; and it is curious to observe the different opinions which mankind in various ages have held respecting their production.

They were known to the ancients. Ovid, in the 15th book of his Metamorphoses, assigns them a very fanciful origin; whence they received the name of *Lapides Lynces, Lyncurium,* &c. They were also known by the denomination of *Idæus Dactylus,* possibly from their resemblance to fingers, and also from their having been found on Mount Ida.

Among the northern nations it was a common opinion that these stones were petrified fingers, fabricated by demons, in order to be used in those mysterious rites of supernatural agency of which their fierce and gloomy superstition fostered the belief. By them they were designated by terms referring to such agency, their common names being those of "Devils' Fingers"—"*Spectorum Candela,*" &c.

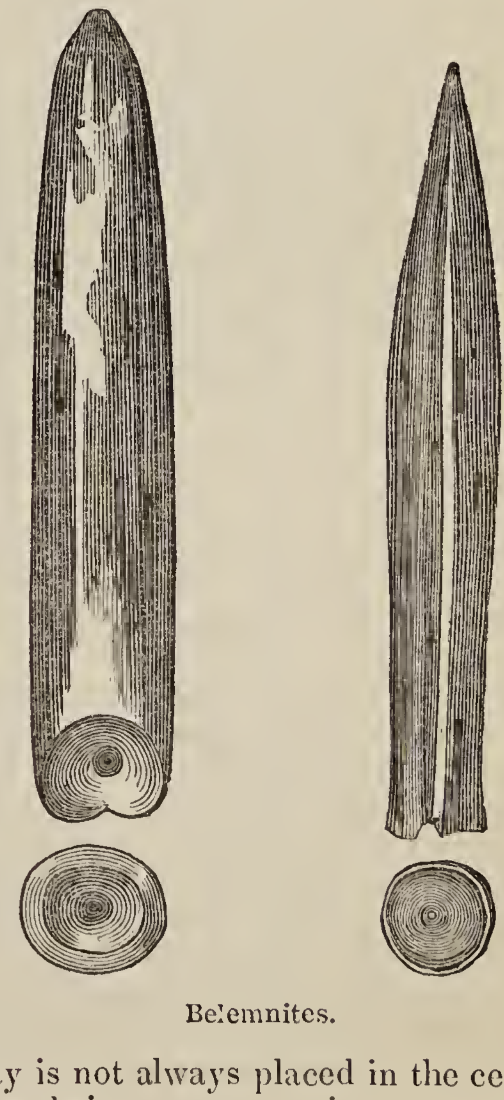
As fossils came to be better understood, the belemnite was supposed, on account of its conical cavity, either to be the remains of the tooth of some unknown animal, or, as it was usually found associated with marine productions, a spine similar to that of the echinus.

When at length, with the advance of science, it came to be considered as the remains of a testaceous animal, new theories and conjectures arose. It was first supposed to be a dentalium, then a limpet; but further observations at last proved it to be the remains of a univalve shell, divided into chambers, pierced by a tube, and similar in their construction to those of the nautilus, which was inclosed in an outer case or sheath, having a sparry mineral structure, radiating from an axis, passing perpendicularly through the fossil, which, in its most perfect state, is formed of carbonate of lime.

When perfect, it presents the appearance of two conical shells, the apex of the one being inserted into the base of the other.

Its general appearance is that of a straight, elongated, conical shell, formed of two distinct and separate parts. The external being a solid sheath, having a conical cavity in the upper part, which contains an internal conical nucleus, which is pointed and chambered transversely through its whole length. The chambers are slightly concave on the one side, and convex on the other, perforated by a lateral siphuncle.

The outer case is most commonly found without the nucleus, being merely the sheath, of the internal conical mass; its form is that of a long cone, more or less pointed; and it often has a lateral groove; it becomes solid as we approach the apex, whilst the base is perforated by the conical cavity before mentioned, for the reception of the multilocular nucleus.



Belemnites.

This cavity is not always placed in the centre of the cone, there being numerous instances of its being placed on one side, and a division passes from its point to the apex of the cone.

The very valuable researches of the late Mr. Miller have thrown much light upon the probable origin of these very singular fossils. They are detailed in an interesting paper read before the Geological Society, and which is published in the second series of their Transactions, vol. ii. He observes, that "the chambered structure of the conical shell of the belemnite and its siphuncle exhibit a striking analogy with the orthoceratite, the nautilus, and the ammonite. It differs, however, essentially from the orthoceratite in the circumstance that all the parts of its shell present, on fracture, a laminar, fibrous, spathose substance, in its being provided at its posterior end with a more or less elongated and encompassing guard or sheath, and in the siphuncle of the chambered cone being situated near the margin. This last character, combined with the fibrous and spathose texture of the shell, at all times affords a discriminating character between the chambered cone of the belemnite, even when occurring separated from its guard and the orthoceratite."

From this analogy of the belemnite to the nautilus in the chambered parts of its shell, he considers that no doubt can remain of this shell having been, like that of the nautilus, intended to increase the buoyancy of the animal to which it belonged; and also that the chambers of the internal cone were formed at various periods, as the growth, &c., of the animal required. This chambered part appears to have extended very much beyond and above the upper extremity of the guard or sheath, and also to have been in the upper part of much larger dimensions. He also conjectured that the last, or outer chamber, did not appear to have possessed, at any time, any great depth; but later observations have shown this opinion to be erroneous, specimens having been found in Germany in which the outer chamber is of considerable depth. The guard or sheath varies much in different species; in some being fusiform, in others concave; in some it is but slightly elongated, in others of considerable length; in some it has a round, in others an elliptical circumference; its termination is either acutely pointed, conical, compressed, mamillated, or even slightly hooked. In some species one longitudinal groove is found, in others two or three; and in some impressions, may be traced which are evidently the marks of muscles which have encompassed this part of the belemnite, and which show the impressions of branching vessels. These appearances are more particularly to be seen upon those which are found in the chalk. In those which are transparent the guard appears to be formed of two or three nearly equal longitudinal portions, which may be easily separated along the line of their adhesion by a slight blow of a hammer. The edges of these longitudinal portions are irregularly waved, and adhere closely together.

If we examine a longitudinal or transverse fracture of the sheath, we find it to be formed of several concentrically superposed laminæ, perfectly corresponding in structure with those in the chambered cone. Its general appearance is that of a substance radiating in lines from a centre to the circumference, which centre is formed by the prolongation of the point of the conical cavity in the upper part, and is supposed to have been produced by the decomposition of the nacreous matter of which it was originally formed.

From various circumstances it is concluded, that this shell was secreted by the animal much in the same state as it is now found, and that it was like that of the recent, and, with respect to its chambered divisions, analogous genus Spirula, inclosed in the body of the animal; and thence it is conjectured that the animal to which this shell belonged was like that of the Spirula, one of the cephalopodous division of Mollusca, that it held an intermediate place between the two subdivisions of those animals, the Nautilaceæ and the Sepiaceæ, uniting the internal multilocular shell of the former with the laminated calcareous mass of the latter, and that in form it resembled the sepia, or cuttle-fish, having a body of an abbreviated form, partly inserted into the first or upper chamber of the internal cone, and connected to it by a duct extending from it to the end of the siphuncle, and also having powerful muscles extending over the guard for its whole length, having secreting surfaces, and capable of encompassing it.

The figure given in plate 2, Fossil Remains, is that of the *Belemnites elongatus*, a species which is found in the oolite and lias. It is taken from a remarkably fine specimen in the possession of J. S. Bowerbank, esq., F. G. S., and exhibits in a very beautiful and satisfactory manner the upper or chambered portion, with its divisions or septa, inserted into and extending beyond the elongated conical sheath, which in this species is long and narrow.

BELVISIACEÆ, or BELVISIEÆ. A natural order of plants, containing only a few genera and species: it seems to be allied to the Styracineæ. The characters of the order are:—calyx of one piece, with a divided limb, persistent; corolla monopetalous, plaited, deciduous; stamens inserted at the base of the corolla; ovary adnate with the tube of the calyx; one style; stigma lobed or angular; fruit, a many-seeded berry.

The plants included in this order are shrubs which are found in South Africa and Brazil. Their properties are as yet unknown. The chief genus is Belvisia, whence the name of the order is derived.

BEMBECIDÆ (Leach). A family of hymenopterous insects belonging to the division Aculeata, and section of burrowing sand wasps (Fossores). In the Linnæan system the species were arranged with apis, on account of the length of the tongue. The legs are short, or but of moderate length; the fore legs of the females being furnished at the sides with very strong spines for burrowing in the sand. The collar is transverse, not extending to the base of the wings. The head appears transverse from above, the abdomen is of an elongated semiconical form, and the upper lip is exposed. These insects are chiefly inhabitants of warm climates, and their bodies much resemble those of wasps, being generally variegated with yellow, and black, and smooth; the antennæ are inserted close together, and the jaws are long, narrow, and toothed at the tips. The abdomen is generally armed beneath with one or two spines in the males. The perfect insects appear in summer and fly with great rapidity from flower to flower, making a sharp buzzing noise. Many of them emit a scent similar to that of roses. The habits of these insects have lately been investigated with much attention by the count de Saint Fargen, whose observations we shall here introduce to the English reader. The females form oblique cylindrical burrows in sandy situations, and provision them with perfect dipterous insects; *Bembex rostrata*, for this purpose, indifferently collects drone-flies (*Eristalis*), the species of Stratiomys, and large species of common flies (Musca, such as

Vomitoria). *Bembex tarsata*, according to Latreille, selects *Bombylii*. As each cell is capable of containing five or six flies, the female frequently follows her prey during the period of deposition of her eggs. Each time she quits her burrow, she shuts up the mouth with sand to prevent the entrance of enemies. Although these insects work singly, and not socially, the same bank generally contains the nests of many females, thirty of the latter having been observed in the space of twenty feet. When a sufficient quantity of flies have been collected and imprisoned in the cells at the end of the burrows, the female deposits a single egg in each cell, carefully closing its mouth; the grub, when hatched from the egg, devours the flies, and then passes into the pupa state, from which it soon afterwards emerges as a perfect insect. Certain species of Chrysidida or golden-tailed flies, including the *Parnopes carnea*, seize the opportunity of the absence of the female bembex to deposit their eggs in the already-provisioned nests, the spined structure of their legs enabling them to make their way through the entrance. The Parnopes have been observed entering the burrow tail foremost, when it is evident that her object is to deposit her eggs therein. When hatched, the grubs (one only being found in each cell), in the following spring, attack the legitimate inhabitant of the cell, which had attained its full size in the autumn, and destroy it. Thus it is throughout nature. The bembex larvæ feeds upon flies; the parnopes larvæ devours the bembex larvæ.

One species of this family alone has been introduced doubtingly into the British catalogues; no decided instance of its capture having occurred. It is the *Apis rostrata* of Linnæus. The family comprises three genera; namely, *Bembex*, tongue long, upper lip triangular, palpi short; *Monedula*, tongue long, upper lip triangular, palpi long; *Stizus*, tongue short, upper lip short and rounded.

BEMBIDIIDÆ (Stephens). A sub-family of coleopterous insects, belonging to the section, and forming portion of the great division constructed upon the Linnæan genus *Carabus*. Mr. MacLeay united the insects composing the sub-family, but they appear to be at once distinguished from all the other groups of carabideous insects, not only in their structure and diminutive size, but also in their habits.

They may be characterised by their fore-shanks being furnished with a notch, the elytra rounded at the extremity, the abdomen not attached to the thorax by a footstalk, and the external feelers of the lower jaws terminated by a very minute and acute joint, and the antennæ are of moderate length. Unlike the majority of the Carabidæ, these insects are generally found in damp, low, and marshy situations. They are, for the most part, to be met with under stones, beneath which they hide themselves, most probably because it is in such situations that they meet with their prey; the structure of the mouth evidently indicating sufficiently predaceous powers. It is supposed that they feed upon still more minute insects than themselves. They are of a very small size, of highly-polished and metallic colours, and often ornamented with spots of pale colour upon the dark ground-work of their wings. Some of the species, especially those that constitute the restricted genus *Bembidium* of Latreille, have very much the resemblance of small tiger beetles; indeed they were placed in the genus *Cicendela* by Linnæus. This family is rather extensive, upwards of seventy species being recorded as natives of Great Britain and Ireland. These have been arranged by Zeigler, Megerle, Stephens, Leach, &c., into ten genera: namely, *Lymnæum*, 1 species; *Cillenum*, 1 species; *Tachys*, 8 species; *Philochthus*, 6 species; *Ocys*, 3 species; *Peryphus*, 16 species; *Notaphus*, 9 species; *Lopha*, 11 species; *Tachypus*, 9 species; *Bembidium*, 4 species. These genera, with few exceptions, rest upon minute differences in the form of the thorax and other slight characters, which, however, it seems necessary to have recourse to for the purpose of distributing the extensive group into convenient divisions.

BERBERIDEÆ. The Barberry Family. A natural order of dicotyledonous plants, containing seven known genera and forty-seven species. It is nearly allied to the Menispermaceæ, or coculus tribe. The essential characters of the order are:—sepals or leaves of the calyx, three, four, or six, deciduous, in a double series, accompanied by scales; petals hypogynous, equal in number with the sepals, and opposite to them; stamens equal in number to the petals, and opposite to them; filaments short; anthers oblong, two-celled, opening by valves; ovary solitary, one-celled; style oblique; stigma orbicular; fruit, a berry or capsule, containing from one to three seeds.

The plants in this order are shrubs or herbs with perennial roots, found in temperate and cold climates in both hemispheres. Species have been met with in Europe, Asia, North and South America, but none have as yet been detected in Africa or the South Sea Islands. They are propagated by cuttings, layers, and seeds. Their properties will be best shown by a few examples.

The chief and most interesting genus is *Berberis*, whence the name of the order has originated. *Berberis vulgaris*, the common barberry or pepperidge bush, is common in the hedges and woods of Great Britain. It presents a beautiful appearance in spring, when covered with its yellow clusters of flowers. As the season advances, these are succeeded by bunches of red oblong-shaped berries, which are familiar to all. These berries have a sour taste, owing to the malic acid which they contain. They enter into the composition of various sweetmeats and tarts, and when prepared with sugar they form an excellent jelly. When pickled in vinegar, they are used for garnishing dishes. In consequence of their acidity and astringency they are refused by birds. They form a grateful cooling drink in fevers, and are said to be useful in biliary fluxes and internal hæmorrhages. The leaves of the barberry are yellowish or bluish-green, and possess a considerable degree of acidity. The stem and bark are very astringent, and are employed in dyeing; the root resembles that of the pomegranate: it is bitter and styptic, and is used in Poland for the purpose of imparting a yellow colour to leather. Cows, sheep, and goats eat the plant, while horses refuse it. Varieties are cultivated, with purple, white, yellow, black, and seedless fruit.

A singular irritability has been observed in the filaments of the barberry. If their inner side be touched with a pointed instrument, such as a needle, they immediately contract, move towards the stigma, and scatter the pollen if it is ripe. A peculiar fungus also grows on the plant, which is said to be prejudicial to corn growing near it, by causing blight or mildew. (See article ÆCIDIUM.)

All the species of barberries are more or less ornamental. The *Berberis aristata* is a hardy evergreen shrub, found in Nepal. *Berberis tinctoria*, a native of India, yields a yellow colouring matter, which is used in dyeing. *Berberis Siberica* (Siberian barberry), is

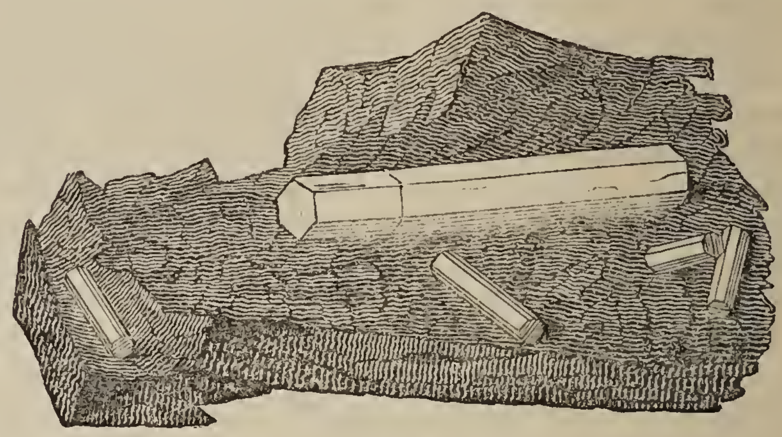
Berberis epimedium, Siberica.

a curious species known among the Mongol Tartars under the name of Yellow-wood, and applied by them both to superstitious and medicinal purposes. It is a native of the Altai mountains, growing in the crevices of the highest rocks, and was introduced into Britain by Sir Joseph Banks in 1790. It produces grey or ash-coloured berries, possessing acid properties. The barberries with pinnated leaves, generally shrubs of great beauty and interest, have been lately referred to a separate genus denominated *Mahonia*. Leontice, or *Caulophyllum thalictroides*, another plant of this order, is remarkable as being an instance of a plant in which the seeds are not inclosed in any covering whatever. *Mandiana domestica* is an elegant shrub, found in Japan. *Epimedium Alpinum*, or Alpine barrenwort is a plant of the barberry tribe, which is found in a few places in Britain. It is a small elegant plant, with handsome dark red flowers, which grows in mountain thickets, and furnishes a considerable quantity of honey.

BERIS (Latreille). A genus of dipterous insects, belonging to the section Notacantha and family Xylophagidæ. These insects, of which there are about a dozen British species, are of small size, lively colours, sluggish in their motions, frequenting aquatic plants, and distinguished by the basal joint of the posterior tarsi being greatly dilated, and the scutellum armed with six or eight spines. In the species forming the genus *Achna* of Meigen, the scutellum is only furnished with four spines. The antennæ have been described as only three-jointed, but the third joint, as it is termed, is distinctly annulated and composed of eight distinct articulations. These organs are but a little longer than the head. *Musca clavipes* of Linnæus is the type.

BEROSUS (Leach). A genus of coleopterous insects, belonging to the section Pentamera, and family Hydrophilidæ. These insects are of small size, and reside, like the rest of the family, in stagnant waters and ponds, in which, from the imperfect ciliation of the hind legs, they swim but slowly. The genus is distinguished by having the clypeus entire, the antennæ eight-jointed, the eyes very prominent, and the elytra are broader at the base than the thorax. Four British species, the *Dytiscus luridus* being the type.

BERYL. A very beautiful mineral, frequently, though improperly, called Aquamarine. Its principal colour is green, from which it passes on the one side into blue, and on the other into yellow. The beryl occurs massive, and it is often crystallised in long equiangular six-sided prisms. The crystals are sometimes jointed like basalt, having a concave surface at one extremity, and a convex surface at the other. They are seldom single; generally many occur together, and these cross each other in different directions. A very fine specimen, in the collection of minerals at the British Museum, is delineated in the accompanying figure.



Beryl.

The beryl was the tenth stone in the breast-plate of the Jewish high-priest, whereon Zebulon was engraven. When pure, it is cut into ring-stones, seal-stones, brooches, intaglios, and necklaces, but it is not so highly valued as the jewellers' emerald. The darkest green varieties are set upon a steel-coloured foil, and the pale ones are either placed, like the diamond, on a black ground, or upon a silvery foil. Figures are sometimes engraved on it. In the royal library at Paris, there is a portrait of Julia, the daughter of Titus, engraved on a very large green-coloured beryl. The largest ones are said to be in much esteem among the Turks for the handles of stilettos. The beryl, which is now classed with the rhomboidal-emerald, is found in its most beautiful varieties in veins that traverse the granite mountain Adon-Tschalon, in Asia, from which quarter nearly all the abundant supplies of Russian beryl are obtained. It also occurs along with arsenical pyrites, in a kind of serpentine rock near Nertschinsk, in the mountain Tygirek (Mountain of Snow), in the Altain range, &c. It also occurs in Europe and the United States of America. In our own island it is found in alluvial soil, along with rock-crystal and topaz, in the upper parts of Aberdeenshire. In Ireland, imbedded in granite, near Lough Bray, in the county of Wicklow, and near Cranebane, in the same county.

BERYTUS (Fabricius; *Neides*, Latreille). A pretty genus of hemipterous insects, belonging to the sub-order Heteroptera, or bug tribes, and family Coreidæ. The species are of a very narrow and elegant form, having very long legs and elbowed antennæ, which give them much the resemblance of *Tipulæ*, whence the type was termed by Linnæus, *Cimex tipularius*. The author of this article has captured the *Ber. elegans*, in some profusion upon the *Ononis arvensis*, at the back of the Isle of Wight, upon the tender shoots of which the insect in all its states feeds.

BETHYLLUS (Latreille; *Omalus*, Jurine). A genus of hymenopterous insects, belonging to the section Pupivora and family Proctotripedæ. This genus is at once distinguished by its large and flattened head, the elongated collar, and the elbowed and thirteen-jointed antennæ in both sexes. The insects are of small size and of black colours; the type is the *Ceraphron formicarius* of Panzer. They are extremely active, and are armed with powerful jaws. The proceedings of one of these insects has been related by Mr. Holiday, in a late number of the "Entomological Magazine," in a very interesting manner. This gentleman observed a female bethyllus occupied with a full-grown larva in a small pit of loose sand, formed at the foot of the cliffs on the sea-coast. This larva was at least six times the weight of the bethyllus. The latter employed the greatest perseverance in dragging the larva up the sides of the pit, avoiding or overcoming all the dangers occasioned to its passage by the stems of grass, &c., with the most surprising skill. "When it had ascended two feet, it came upon a fragment of reed, partly embedded in the sand, the stem of which was broken off and open below, a few dry elastic shreds of the leaf only remaining. Having reached the part where these grew, it, by a strong pull, drew its burden about half through, till its body was grasped between two of these as in a vice, then letting go, it began to explore the bank on each side to some distance, tapping with its antennæ the conspicuous object; in a few minutes, seeming to be satisfied, it hastily descended the reed, and entered its stem at the lower end: it did not remain long in the interior, and on its reappearance set off for the spot where it had left the larva, which, after pulling it out of the hold-fast, it seized by the mouth as usual, and began to descend the reed again; it did not complete the journey this time, but taking advantage of the same kind of security to detain its prey, it repeated the *reconnoissance*, then returning, dragged it to the opening, and leaving it there, plunged in itself, but immediately reappearing, drew in the larva head foremost, speedily disappearing in the interior, so that I could not observe its subsequent proceedings, and being obliged to turn homewards, I left them undisturbed. I think, however, it will seem probable that the bore of the reed was employed instead of an artificial funnel for the cells which should contain the progeny of the bethyllus, with its store of provisions. If these insects select only full-grown caterpillars, I can scarcely imagine one of the smaller individuals managing these unwieldy bodies."

BETULINEÆ. The Birch and Alder Tribe. A natural suborder of dicotyledonous vegetables, containing five genera and about fifty species. By some authors it is included along with the willow and oak tribe, under the Amentaceæ. It is allied to the Cupuliferæ. Its essential characters are:—flowers monœcious, growing in aments or catkins; stamens distinct, rarely united together; anthers two-celled; ovary superior, two-celled; style single, or wanting; two stigmas; fruit membranaceous, indehiscent; seeds pendulous, naked.

The plants of this order are trees or shrubs which shed their leaves every season, and which are found abundantly in the temperate and colder regions of the globe. Several species are found in the woods of Europe, North America, and the northern parts of Asia, and some are said to grow on the mountains of Peru and Colombia. The order contains many trees which are used in ornamenting landscapes, and which furnish valuable timber. They are propagated by layers and seeds.

The Betulineæ, like the willows, contain much tannin, and possess astringent and tonic properties.

Betula alba.

The principal genus is *Betula* or birch, whence the name of the order is derived. This genus contains numerous species which are highly interesting, and have been applied to important uses. *Betula alba*, common European or white birch, is an elegant tree familiar to every one. It is found in woods and in moist heathy mountainous situations in Britain. It grows in almost any kind of soil, moist, dry, gravelly or chalky, and it is frequently seen issuing from the crevices of rocks. It endures the cold of northern regions well, and is found even at the seventieth degree of north latitude. It thrives well in Lapland, Norway, Sweden, and the northern parts of Russia. It is seldom met with farther south than the forty-fifth degree of latitude, unless upon lofty mountains. On the Alps it grows at an elevation considerably above that at which other trees thrive, but in such elevated situations it becomes very diminutive in size. In general it reaches a height of fifty or sixty feet, with a diameter of a foot and a half or two feet. It blooms early in spring, and sends forth pendulous catkins of flowers. The wood of the birch is hard, tough and white, and is used by wheelwrights, turners, and carpenters, in the manufacture of various useful and ornamental articles. In some countries wooden shoes are made from it. The bark is thick, and is covered with a white scaly cuticle. It is astringent and bitter, and has been used in the cure of intermittent fever. On account of the resinous matter which it contains, it serves for torches to the inhabitants of the Alps. A decoction of the bark is used by the Laplanders in the preparation of reindeer skins. An empyreumatic oil also is obtained from it, which the Russians employ in tanning, and it is from this oil that Russia leather derives its peculiar odour. The inner part of the bark in its young state contains a quantity of fecula or starch, and from it the inhabitants of the northern regions make a sort of cake, which, along with smoked salt-fish, constitutes their food during the winter. The leaves of the birch are bitter, and have been used as a substitute for tea. They dye wool of a yellow colour. A decoction of them is said to possess vermifuge and diuretic qualities, and has been praised in calculous complaints and scurvy. A spirituous infusion of them is employed by the Russians and Swedes as an embrocation in rheumatism. By tapping the birch in spring, a sweetish sap is procured in great abundance, which by fermentation yields a sort of wine called birch-wine or mead. The tops and twigs of the birch are commonly used for brooms. *Betula pendula*, or the weeping birch, by some considered as a variety of the common birch, is the most graceful of the genus, and is easily recognised by its elegant drooping branches. *Betula nana*, or dwarf birch, is another European species found in northern climates, and approaching, in Norway and Lapland, very near the limits of perpetual snow. It is a small diminutive shrub, and is found on the Scottish mountains in considerable abundance. In summer, when the Laplander lives on the mountains, this plant furnishes his fuel, and, when covered with rein-deer skin, forms his bed. Its leaves dye a finer yellow than the common birch. Several species of birch are found in North America; of these the most important is the *Betula nigra*, or black birch, which furnishes a very hard and valuable wood. This wood when recently cut, has a rosy hue, which deepens by exposure to light. It receives a fine polish, and may be made to assume the appearance of mahogany: hence the tree is often called mountain mahogany. The twigs of the black birch, when bruised, give out a sweet scent. *Betula papyracea* is another useful North American species. From the wood of this species many articles of furniture are made, and its bark, which is white and indestructible, is used for the formation of canoes. On this account the tree is denominated the canoe birch. The name *papyracea*, or paper birch, is derived from the circumstance that the bark, when divided into thin sheets, is used as a substitute for paper. The red and yellow birch, two other American species, are not put to any particular use.

Another genus of this order is *Alnus*, or the alder. The alders in general grow in marshy, boggy situations by the sides of rivers, requiring black mould with plenty of moisture. They are often planted in places which cannot be drained. They are propagated by layers.

Alnus glutinosa, or common alder, is a quick growing tree found in swamps and meadows in Europe, North America and the northern parts of Asia. It attains a height of fifty feet, and furnishes a compact wood capable of receiving a considerable polish. In France, wooden shoes, or *sabots*, are made from it, which are seasoned by fire before they are sold. From being able to resist the action of water, the wood is employed in the formation of durable water pipes, and in Holland it is used for piles, upon which buildings are erected in marshy places. It is said that piles of this nature were driven in under the old London bridge. The wood takes a black colour well, and can be made to resemble ebony. With green vitriol, it dyes wool of a black colour. It yields excellent charcoal, which is employed in making gunpowder. The juice of the alder is astringent, and the bark is used for tanning, and for detergent gargles.

Alnus incana, hoary alder, grows in several parts of Europe, and has received the name of cold alder, from not being found south of latitude sixty degrees. *Alnus senulata*, notch-leaved alder, and *Alnus glauca*, are two species found abundantly in North America.

Carpinus betulus, hornbeam, a tree of humble growth, and useful in the formation of hedges for shelter, belongs to the betulineæ. It is found in woods and hedges in England, growing in damp, tenacious, meagre soil. It forms the principal part of the ancient forests on the north and east of London, such as Epping and Finchley. Its wood is hard and used for furniture, and its inner bark yields a yellow dye. *Ostrya*, another genus of the order, receives the name of hop-hornbeam, from its scaly catkins being similar to the hop. *Ostrya Virginica* is a small tree found in the shady woods of America. It supplies a hard heavy wood, called iron-wood or lever-wood.

Corylus is the fifth genus of this order. *Corylus avellana*, or hazel-nut tree, must be familiar to all, as furnishing the fruit commonly known by the name of filberts. This tree flowers early in spring, and its leaves do not appear till after the blossoms. Its wood is used for hoops, fishing-rods, walking-sticks, &c., and furnishes excellent charcoal for drawing. Squirrels live on the nuts, and an oil is prepared from them which is used by painters, and which is said to be efficacious against tooth-ach or worms. *Corylus Americana*, American hazel, yields also excellent nuts.

We have thus seen that the trees of this important order, are applied to many of the necessities of life. The wood of several of them is used for the construction of houses and vessels, in the works of the wheelwright, turner, and cabinet-maker, and as an article of fuel; the bark is manufactured into canoes and boxes, serves for the covering of houses, and supplies materials for dyeing and tanning; medicinal preparations, useful in various diseases, are obtained from several species; from some a nutritious article of diet is procured, while from others a sap exudes which constitutes a grateful and refreshing beverage.

BIGNONIACEÆ (the trumpet-flower family). A natural order of dicotyledonous plants, containing about a dozen genera, and nearly one hundred species. The order is very closely allied to the Pedalineæ and Cyrtandraceæ, and bears a considerable affinity to the Scrophularinæ and Acanthaceæ. Its essential characters are:—calyx monophyllous, divided or entire, sometimes in the form of a sheath; corolla monopetalous, hypogynous, frequently irregular; stamens five; anthers two-celled; ovary surrounded with a glandular disk, generally two-celled, and many-seeded; one style; stigma formed of two plates; capsule superior, two-celled and two-valved; seeds compressed, often winged, not provided with albumen.

The plants included in this order are trees or shrubs, frequently twining or climbing, and inhabiting the tropical regions of both hemispheres. Virginia and Japan are said to be the farthest points to which they recede from the equator, and none of the species are found in Europe. They are much cultivated and prized on account of their beautiful trumpet-shaped flowers, and their broad pinnated leaves. They are propagated by cuttings or layers, sometimes by seeds. Their properties are scarcely known. The wood of some of the species is said to resist the attack of worms.

The chief genus, and that which gives name to the order, is *Bignonia*, or trumpet-flower. It contains numerous species, most of which are highly ornamental. The name Bignonia was given in honour of the Abbé John Paul Bignon, who was librarian to Louis XIV., and a particular friend of the celebrated botanist Tournefort. *Bignonia grandifolia*, gigantic-leaved trumpet-flower, is a rapid-growing climber, found in the province of Caraccas, in South America. Its flowers are of a deep, bright-yellow colour, and its leaves are occasionally a foot and a half long, and nine inches broad. *Bignonia venusta*, welted trumpet-flower, is a climbing shrub of Rio Janeiro, producing flowers of a vivid orange-vermilion colour.

BIGNONIA RADICANS.—*a*, calyx; *b*, corolla; *c*, section of corolla, showing the situation of the stamens; *d*, pistil.

The bitter juice and tender shoots of *Bignonia leucoxylon*, or white-wood of Jamaica, are supposed to be an antidote against the poisonous juice of the manchineel. *Bignonia telfairiæ* is cultivated in Madagascar for the sake of its fleshy fruit, which has an agreeable flavour, and is prized as an article of food. The leaves of *Bignonia chica* yield by decoction a red resinous-like matter, called chica, which is used by dyers, and is employed by the Indians of Rio Meta and Orinoco to paint their bodies red. In commerce it is met with in the form of round cakes, five or six inches in diameter, and two or three inches thick. To cotton, it imparts an orange-red colour. The tough shoots of *Bignonia heterophylla*, or chirire, a native of Guiana, are woven as wicker-work. The leaves of *Bignonia Indica* are deemed emollient. Several species of bignonia found in Brazil, yield excellent timber, used in the construction of houses and ships, as well as in the manufacture of bows.

Tecoma, formerly *Bignonia radicans*, is a hardy climbing plant of great beauty, which ascends the tallest trees and the highest rocks, and is capable of being reared in the open air in this country against a wall. *Iacaranda*, another genus of the order, furnishes species remarkable for the elegance of their foliage, and their beautiful blue or purple flowers.

Catalpa syringifolia, an American tree belonging to this order, furnishes a most useful and durable wood. This tree sometimes attains a height of fifty feet, with a diameter of a foot and a half or two feet. Its leaves are very large, while its flowers are showy and white with violet and yellow spots. Its bark, which is of a silver-grey colour, is said to be tonic and stimulant. Honey collected from the flowers is said to be poisonous. An old catalpa exists in Grays Inn Gardens, which is reported to have been planted by Lord Bacon. *Catalpa longissima* is a most important timber tree found in the West Indies. The French call it *Chêne noir*, or black oak.

The root of *Spathodea longiflora* has an agreeable taste, and, along with the fragrant flowers of the tree, is used in some parts of India, in the form of infusion, as a cooling drink in fevers. The purple sweet-smelling flowers are considered by the Hindoos as acceptable to their gods, and are offered by them in their temples.

The genus *Eccremocarpus* differs from the other genera in this order, in having a single-celled ovary and capsule. The remaining genera are *Amphilobium*, *Fieldia*, *Chilopsis*, *Calampelis*, and *Streptocarpus*.

BIMANA (two-handed), the appellation which is given to man, considered as an order of mammalia, and without reference to his peculiar character, as possessing an intellectual nature in addition to his animal or material one. In consequence of possessing the intellectual nature, man differs so much from the rest of animated nature that he can hardly be considered as part of the system. It is true that, in so far as he is material, his body must obey the laws of matter, or overcome them only by means of organisations mechanically fitted for that purpose, just as is the case with other animals; but when we come to study the structure of his body, and the functions which it is capable of performing, we find that they are regulated by principles to which there is nothing analogous in the rest of creation.

When we examine the other animals in conjunction with the physical circumstances under which they exist, we find so perfect a coincidence between the animal and the circumstances, that we can at once say the one is made for the other, and that the animal is perfect in its place. One is fitted for one climate and surface, and another for another; but they are all equally well-fitted for their several places: and when we attempt to take them out of these, their nature resists; and, if we push the case to extremities, their life yields. But man is not completely in his element any where in wild nature, and as little can we say that any where he is completely out of it.

Place man in the very richest spot that can be found upon earth, and notwithstanding the richest luxuriance of nature—that luxuriance in which all the rest of the creatures wanton, as it were, in the fulness of enjoyment,—there is so far from being enough there for the full development of his powers, that these seem to remain inert and he to languish, in proportion to the richness of that plenty in the midst of which he is set.

But still the case is not one of merely physical consideration, in which as we move from the one end of the scale to the other the result is subject to a uniform change; for when we take the opposite character, that of the earth where it is the least productive, we find that it is nearly as unfavourable to the full development of the powers of man as that in which natural production is at a maximum.

From this we are compelled to acknowledge that there must be something more in man than merely an adaptation to the general laws and action of material nature . for if not, then assuredly man forms an anomaly in the creation—an imperfect creature, while all else is most admirably perfect.

When we consider the other creatures in a state of nature, and the natural circumstances under which they exist, we find the adaptation of the one to the other, and also the relation of every creature to the whole, so complete, that we can have no hesitation in at once pronouncing that they and all their adaptations are entirely parts of the one system and design of the present world; that their sole end and purpose are accomplished when they have borne their part in that system; and that, in order that the accomplishment of this end and purpose may be sure, we find all the species in all their varieties acting upon, or, as we may express it, governed by, instincts, which are as constant and immutable as the laws of inorganic matter.

The induction is often (generally indeed) a long one, and therefore we become impatient for the conclusion; and filling up, by analogies drawn from ourselves, those chasms which our ignorance leaves void, we come to a wrong one. We impute design on the part of the creature itself, in cases where, if we studied them a little more intimately and attentively, we should find no more self-design than we can suppose there is in the parts of the earth adhering so as to form our globe, or in the motions of that globe upon its axis, and round the centre of gravity of the solar system. All material movements, whether of a planet in its orbit, the mightier movement of a system of planets in space, or the pulse in the smallest insect, or the motion of growth in the minutest body, belong to the same general class; and, how much soever they may vary in their details, they have one law which is general and the same to all—they are not the result of any purposes in those creatures, animate or inanimate, by which they are displayed. We do see the most perfect design in every action which takes place, and every phenomenon which presents itself in nature. We do also find wisdom, and wisdom which, when once we are able to see it, we never can enough admire, in all and every part of nature. But the design which we trace is the Creator's design; and the wisdom which we see is His wisdom.

It is not in the superiority of the design and the wisdom alone that we see that such must be its origin. If the proof rested upon that, its foundation would be very unstable. We are, no doubt, in the habit of saying that we see demonstrations of *infinite* Wisdom, but that is the arrogance of our own self-deceit. We are *finite* in all our perceptions, mental or bodily, and, therefore, we cannot, in the nature of things, perceive or comprehend *infinitude*. The word itself is a *negative*—a name for that of which we are ignorant, and we cannot found a definition or form an explanation upon it. But still we can no more doubt the infinite than we can doubt our own existence; for we are hemmed in by the infinite in all our studies of the finite, whether they be more or less profound. This feeling accommodates itself to the capacity of every one who thinks; for, whether it be more near or more remote, the end of what we know is to us the beginning of infinitude.

The perfect harmony and adaptation to each other of all the parts of material nature is of itself sufficient proof that there can be purpose or will (for what we call will is nothing but forethought purpose) in none of them; because of themselves they could not preserve the harmony, unless each of them knew all that existed or could happen. Either, therefore, we must suppose every creature, nay, every atom of matter, to be endowed with omniscience, in other words to be a god, or we must admit that the whole obey the law of One God, and obey it, not as a matter of knowledge and judgment, but as a part of their very natures, which it would be absurd to suppose that they have, or can have, any disposition or tendency to resist. The doctrine which would endow matter with the attributes of godhead is perfectly untenable; and it is so, for this very simple and obvious reason, that there cannot possibly be two infinitudes of wisdom and power any more than there can be two infinitudes of space, or two eternities of duration. Whatever is infinite, that is, *unknown* and *unknowable*, as the phenomena of matter are known or knowable, must be infinite in all its attributes and in its essence, and that essence must in itself be *one*, in whatever mode or modes, or by whatever agency, its attributes may be manifested to us.

We are, therefore, to consider the material creation as one system, the workmanship of one Author, and sustained by one system of laws, which we may, without impropriety, call the General Providence of that Author. As such, all its parts change together, or at least in proportion as their nature yields to those circumstances which produce the change; and there is not among all the varied creatures a single race that can of itself either hasten its increase or protract its extinction. All creatures which require food can seek and find that food; but not even those which we regard as the most sage and the most powerful can in any way directly augment the quantity of that food, though, taken along with other circumstances they may be, and often are, the causes of its increase. Beyond the range of their instincts they have no power; they yield to circumstances; and when these press sufficiently upon them they become extinct, without any of that self-destruction by means of which the human race, considered as one species, make their lands desolate. When we take this view of material nature, and it is the only rational view which we can take, it becomes necessary to separate man from the other animated tribes; and then the study both of him and them becomes consistent, instructive, and free from embarrassment. To do this is merely taking a step similar to other steps which have been taken, greatly to the advantage of the science, both as a rational exercise for the human powers, and as a means of acquiring facts and principles, the applications of which are useful in the business of life. There was a time when, not only many of the specific distinctions in all the three kingdoms of nature were unknown or misunderstood, but when it was the habit, even with those who were considered as learned, to confound minerals, animals, and vegetables, especially in those obscure cases where the properties of neither are well understood; and not only this, but a disposition has been shown to endow the globe itself with a living, and in some sort an intellectual principle,—an *anima mundi*, or soul of the world, which gave its motions not to our earth merely, but to the whole system of nature, and was at the same time the life of every individual creature. This, though to us it appears an absurdity, was really a direct acknowledgment of the existence of the Creator, and of the operation of that system of laws emanating from him, which we have called his General Providence. It was merely the feelings confessing the power of the Creator, while the mind was too ignorant for forming any thing like a correct notion of him. It was, in short, an idol, only not a material one, or at least one not made by the hands of the artists; and where the light of revelation has not come, it seems to be a general law of human nature that God, when first confessed and sought after, is shadowed forth by idols. Those idols, too, are imagined in accordance with the leading habits of the people: among barbarous savages we have the god all terror and the worship all blood; and so on through the endless succession of names in the various mythologies, till we come to that which may be considered as probably the highest natural effort of man—the idol of the early student of nature—a living principle pervading and acting upon the whole; and though it must be confessed that this conception comes far short of the truth, when that truth is once *revealed*, yet it must be admitted that it is not only in the way of the truth, but the best preparation of the mind for its reception, and the very nearest approach to it which man in his own strength is capable of making.

Nor need we much wonder, though there are transient apparitions of the vision of this idol, upon the misty confines of all the kingdoms of nature, continued downward even to the times in which we live. There is a strong natural disposition to keep the pretension to knowledge quite up to the reality; and, sometimes vanity, sometimes the wings of a name, wherewithal to rise in the world above the proper level of our deserts, push it considerably ahead. In these cases it is easy to see that the whole measure by which the pretension is thus set in advance of the reality, must be composed of idols of some sort or other, inasmuch as there is nothing else of which it can be composed. These little aberrations are, however, harmless, in proportion to the extent of real knowledge, and they are besides a short-lived race; because every succeeding idolator is much more intent upon breaking the idols of his predecessors, and setting up his own idols in their stead, than on studying those truths in advance of which the idols are set.

It is only upon the shadowy confines that such phantoms in natural history can now be conjured up, even by the most fond pursuer of phantom celebrity. But the connexion between man and the rest of material nature, and the distinction between him and that, which coexist and are inseparable, render the study of man, regarded as a portion of that class of animals which in the structure and functions of his body he most nearly resembles, *the* portion of the subject upon which assumptions of this kind are the most likely to be made, and, being made, the most certain to be dangerous. It is for this reason chiefly that we shall treat of that part of the character of man which belongs to natural history in a separate article under the word MAN, rather than under the present article, as the name of an order of mammalia.

At the same time it must be admitted that the separation of man from those animals with which he used formerly to be combined, and in part confounded, in the systems (see APE and BAT), is an important step towards improvement. We thereby get rid of that continual appeal from man to other animals, or from other animals to man, which used so much to disfigure the pages of writers on natural history. When the comparison is one of mere structure or organisation, it is perfectly legitimate, and may, indeed must, be productive of advantage. The human body is made of the same matter, and very nearly the same kind of matter, as the other mammalia; and, in so far as the mere action of the structure is concerned, the analogy holds. Man feeds, and breathes, his pulse beats, and all his merely animal functions are performed, in the same kind of way as those of the other mammalia, though the mode is different, just as there are differences of mode among these; and, as is the case with these, the organisation is adapted to its purpose with the same perfection of form and economy of materials, so that the knowledge of the one leads us to the knowledge of the other, in so far as both are composed of matter, and sustained by those laws of common animal life in matter, which are necessary for enabling the organic being so far to overcome the resistances of inorganic matter as to be able to perform its functions.

But here there is a limit: in the case of every animal, when we have duly studied that animal, and also the earth in its various latitudes and productions, we can lay our finger upon a precise point of the map, which we know to be under given circumstances at the place of our making the assertion, and say, not only with perfect confidence, but in the spirit of the soundest philosophy, "Here is the proper home and dwelling of this animal." But we are altogether unable to pronounce thus in the case of man; for all the earth is his habitation; and though, for the mere support of his animal nature, he is obliged to toil more in some situations than in others, there is no latitude from the equator to the pole but which can be his home and dwelling place.

Man can endure greater variations of temperature than any other animal. He cannot instinctively repel that which would either mechanically crush or chemically decompose the substance of his body; but he can avoid the one, and blunt the virulence of the other by contrivance,—a power which no other animal possesses. He cannot endure boiling water, neither can he bear to be frozen into solid ice; but if the air is dry, he can bear a heat very considerably greater than that at which water boils, or a degree of cold more intense than that which freezes mercury. In the experiments that have been made of exposure to very high temperatures, the length of time has not been so great as to warrant the belief that man could live permanently under so great a heat; but as those experiments have generally been made by immediate transition from common temperatures to the high ones, the oppressive heat, which has soon begun to be felt under them, affords no conclusive proof that man could not exist habitually under such a temperature, if duly and gradually prepared for it. The intense cold is usually guarded against by an increase of thick clothing, formed of materials which are bad conductors of heat; but it is probable that this also is habit, at least in great part. Though we cannot implicitly believe all the accounts which the historians of antiquity have left us of those rude nations upon which, in those times, civilised man showed such a disposition to make war; yet it is highly probable that in the early ages, the people of middle Europe, and those of Britain among the rest, went naked or nearly so, for at least the greater part of the year; and at the present time, the people where the Highland kelt is worn, do not find the exposed parts of their limbs, either more affected by cold, or more liable to become diseased, than those who attire themselves more closely. The fact seems rather the reverse; for it is proverbial, that a genuine *gluine dhu*, which was never once cased in cloth, can stand on the march against the best knee that ever was defended against the weather from infancy upward.

It must be borne in mind, too, that, at the period when the natives of Europe are represented as having gone wholly, or nearly naked, the climate must have been colder, if not upon the average, at least in winter, than it is at present. We have direct evidence, from the freezing of the Tiber, that the Campagna di Roma was much colder then than it is now; and the same may be said, with equal confidence, of the valley of the Danube. If such was the case in those southerly places, which are not much elevated above the mean level, much more must it have been the case in places having a greater elevation, or lying nearer the pole.

It is no doubt not only true but highly probable that the summers were warmer then than they are now; indeed, in Britain at least, there has been a remarkable tendency to equalisation between those two seasons during the last half century; and many places in the north, and towards the wilds, which were, fifty years ago, buried under snow for four months of the year, and scorched by unbroken heat during other three or four, have now comparatively mild winters, and summers refreshed by occasional showers, in consequence of cultivation having forced vegetable action over a greater part of the year. That vines are said to have been abundant in the south of England, and the vintage from them good, in former times, while they do not now bring their clusters to such maturity as to furnish a sufficient quantity of saccharine matter even for tolerable wine, proves nothing as to the general temperature. The vine is a hybernating plant, coming out rather late in the season, but rapidly when it does come; and therefore all that its maturation would prove would be the heat of the summer, which, upon other principles, we may conclude to have been greater in former times than now; and we have a corroboration of this in the wild berries which the country still affords, which are not only not so vinous and racy on the warm bottoms as on the bleak heights where the winter is cold, but refuse to come to maturity at all in such situations.

Many other facts might be adduced, all tending to show that the constitution of man is so formed, or so flexible to circumstances, that he can command all latitudes; and even in those places which are accounted decidedly unhealthy, it is not to difference of temperature that the unhealthiness is wholly or chiefly owing. When that is natural, excessive humidity or excessive drought is generally found to conspire with temperature; and sometimes, as in the case of the *malaria*, on the plains of Italy, along the Mediterranean shore, the pestilent quality of the climate does not appear to have much to do either with heat or with humidity.

It would perhaps be too much to say, that in all places where man finds an unhealthy climate, it is his own fault; because there are phenomena in nature the controlling of which is above any means that the skill of man can use, at least for the production of immediate or even very rapid change. But still, so much has been done in the way of amelioration, that it is not very easy so to fix a limit as to say confidently that nothing beyond it can be done. Farther, it appears, that where the climate is apparently unfavourable to human life, the mode of living has always at least as great a share in it as the mere locality. Thus the conclusion that man is fitted for all the earth, and all the earth for him, or if not so, naturally capable of being rendered so by art, if not altogether universal, is at least very general.

It is much the same with regard to the necessaries of life, as with the fact of living. There are very few situations in which human beings, duly informed and prepared for the purpose, cannot find subsistence. No doubt, there can be no cultivation above the line of perpetual frost, and as little can there be any upon the dry and shifting sand; but the line of frost may be made to retreat upward, if cultivation is pushed vigorously against it; and though the process is often both slow and laborious, the desert is not utterly irreclaimable. There are many instances on a small scale in our own country, and Holland is a remarkable one of the change of a soil naturally bad, under a climate assuredly none of the best, into the garden of Europe. Many of those places which are now desert were formerly the abodes of plenty and activity, and they have been deteriorated through the neglect and misconduct of man, and not through any natural cause. We do not know the properties of all plants, or the modes which are best for improving them into human food, but from the thirsty soils in which water melons, dourrha, rye, and various other cultivated vegetables, come to maturity without almost a drop of rain, we must not say that any one place is utterly hopeless.

It is true that the very principle which enables man to combat with, and, in the end, subdue the climate and the soil, operates against him when he goes to a place the appearance and circumstances of which are wholly new to him. We always proceed by imitation, sometimes by imitating that which we ourselves have observed, but more frequently by imitating others. Thus, those who have been brought up in any society acquire the habits of that society, and cannot shake these off without considerable difficulty when they move to places where they do not so well apply. In consequence of this, the experienced sometimes fail, when those who must depend wholly upon observation succeed.

To guard against the consequences of this implicit and unreasoning adherence to habit, or to following the example of others, which is sometimes unwise, even where very general and of long standing—and when wise, often wise only because it is local—is one of the greatest advantages which result from the counter habit of observing for ourselves, and understanding the cause of success before we imitate that which we observe to succeed in others. The observation requisite for this purpose is nowhere to be found but by attending to what takes place in nature. Considering practical advantage as the good of that which is done, we never can, by observing only the conduct of men, decide whether that conduct is the best possible or not, because we go to measure without any standard; but when we study those substances and events which are the subjects of human action, so as to know the extent of their capabilities, this becomes a standard, by the application of which we may safely try the conduct of others or of ourselves in all cases where it becomes necessary.

The comparison with this standard of knowledge is the process to which the several names of sound judgment, reason, good sense, and various other commendatory terms of similar import, are applied; and the only means which we have of possessing ourselves of the standard, without which there can be no comparison, is *observation*. This, though the organs of the senses are its instruments, is in itself entirely an intellectual operation, and one which no animal possesses, or can possess, in common with man. It is his grand characteristic,—that which, without going into either his physiology or his history, is the purpose to which the whole of his organisation tends. Other animals have senses, and many of them have probably senses different altogether from those of man, or if of the same kind, more acute in degree; but all their senses tend to mere animal preservation: and beyond this they have no speculation; no tendency to notice, or in any way heed, that which is around them. All their organisations tend to these purposes; and this is the reason why the animal, the locality, and the food are reciprocally adapted to each other; but as man is organised chiefly for observation, and for observation of all that nature presents in space or in time, the structure of his body is not an index to any particular locality or climate. If we may so express it, the material or organic part is an inferior portion of a human being; while in the rest of animated nature it is the whole of the creature. The animal is complete in its instincts; and in these it forms a perfect member of the system of material nature; but as we cannot imagine a human body to exist without the mind or intellectual part, how much soever that part may be clouded by ignorance or concealed by disease, we cannot regard the human body as an entire creature at all. It is that wherewith something superior to matter is to work; and therefore if by any circumstances that superior part cannot work, the body is as inefficient as a tool is without the workman.

We have melancholy proofs of this, in those cases of disease to which the name of mental derangement is usually given. The name is evidently a faulty one; because to be diseased or deranged is quite incompatible with the simplicity of essence, and the eternity of duration, which are the essential attributes of the mind. Even those diseases must be bodily; but as they do not necessarily and immediately produce any topical or systematic effect upon the body, which in its material structure follows the general law of material creatures, we are unable to point out where the disease lies, or in what it consists. But we can see clearly that when this connexion between the intellectual and the corporeal part of a human being is disturbed, that being does not descend in the animal scale, and take the habits of some creature in which the organisation is less developed than in the human subject. It does not fall into a regular government of instincts—does not become more uniform and consistent in its acting, than a sane human being. It becomes a fragment—a thing of ruin—unfit for its proper function in creation, and equally unfit for the humbler one of an unreasoning animal.

Thus viewing man in any light, in which with a knowledge of the facts before us, he can be viewed, we find it impossible to class him with the other animals, because we cannot find his peculiar place in merely material nature; and therefore a system which includes him in the same manner as it includes the others cannot be natural. Even when we take the single circumstance of the hands, and call the race *bimana*, or two-handed, as distinguished from the *quadrumana*, or four-handed mammalia, we find that, although there is some resemblance in the organs on which we found the names, they are so far from being similar in their structure or their uses; that we might with quite as much propriety take the distinguishing character from the feet, and style man a *biped*, to distinguish him from those mammalia which are quadruped. The hands of the quadrumana are (see the article APE) feet, and feet limited to peculiar habitations, or adapted for locomotion which answers upon only a limited portion of the earth's surface. No art of man could people with them the pine forests of the North, or even the groves of deciduous timber trees in the latitudes of a mean temperature; nor is it an easy matter to keep a single individual in health for any length of time in our climate, even with the aid of artificial shelter and careful feeding.

It will be said that apes are observant animals, and carry their observation so far as to make it the foundation of imitation. But the observation which we find in these animals is not of the same kind with that which forms the grand distinguishing character of man. It may be more acute at moderate distances than that of many other animals, because that accords with, or is necessary for their natural habit of sitting or climbing among the branches of a tree, and scrutinising the twigs in quest of fruit. But there is no evidence whatever of any observation of events in their succession, which can be made the basis of analogies of cause and effect; and it is this observation of the successions, and not the more simple gaze at the substances or the occurrences, which constitutes in man that observation which is his grand characteristic.

So far as we can feel in ourselves, and judge from analogy, the material organ of sense, whether it belong to man or to any other animal, can perceive matter only; and thus far the perception by the same kind of organ is probably similar in all, because, thus far all are material; but there is an after process in man which has not any material type, and which, therefore, cannot be perceived by any material organ. This is the only part of the process which can be considered as purely mental; and it is the part which is knowledge, or science; remaining with the individual as a guide in future cases, and capable of being communicated from individual to individual, and handed down from generation to generation. The merely animal sensation, or perception, even in man, cannot be thus communicated or transmitted. In itself, and without the mental process which discovers the relations of the sensation to the object of sense, and to other sensations and other objects, the sensation is a mere feeling of pleasure or of pain according to circumstances. This is the case whatever be the sense which is affected. Those who have been born blinded, by means of an opaque film covering their otherwise perfect eyes, who have lived for some time in that state, and who have afterwards had the film removed by an operation, so that they could see, have described the feelings at first resulting from their newly-acquired sense, as if the objects seen touched the eye, bright and especially red colours producing pain similar to that inflicted by a sharp instrument. In the case of hearing, where the relation between the sensation and the sounding body is not so direct and clear as between sight and the visible one, an unexpected sound of unusual loudness has very much the feeling of a blow on the ear; as for instance, when a piece of ordnance is unexpectedly fired, a person not accustomed to the report of cannon, will, if standing near it, clap his hands on his ears, just as persons do upon any part of the body, in which sudden and severe pain is felt. And though this feeling of pain is a mere deception, the sensation is so strong that there have been instances of the party falling down, in the full belief of being shot. The ear does receive an injury, though of what kind it is not very easy to say; because those who are for the first time in a hot cannonade, become deaf to the reports, though after a time the ear recovers its tone, and the hearing returns.

Many other instances might be adduced, all tending to prove that there is no knowledge produced by mere animal sensation; and that, therefore, if there were not in man a principle in addition to the material body, man could not acquire any knowledge capable of being communicated to others, or of forming the basis and guide in future plans and trains of conduct in himself. If the knowledge is capable of being used by the party himself upon future occasions, it follows, as a matter of course, that it can also be communicated and rendered useful to another party of similar understanding,—the only addition required being a means of communication. We need hardly add that language spoken, or expressed by symbols of some kind or other, is the means of communication among man; but it is worthy of remark that while these idiomatic expressions which denote merely local modes can with difficulty be translated even into an analogous language, the truths of science readily admit of translation into all languages, unless where the language happens to be that of a people who are too ignorant for understanding them.

Animals do communicate with each other; but their means of communication are very limited, and there is no ground whatever for supposing that they can communicate any thing at all resembling those truths to which we give the name of science or knowledge. They communicate merely animal sensations, the same as human beings communicate by dumb show and inarticulate sounds; and they are without the reflective sentiments,—the mental emotions, which in human beings may arise from these, just as the mental perception of relation follows the affection of the senses in other cases.

We have preferred this mode of viewing the grand fundamental distinction between man and the other animals, to the other one of arriving at the same conclusion from an examination of the organisation of the human body, because it is more satisfactory, and also admits of being treated in a more popular manner. But when, carrying the distinction which we have attempted to describe along with us, we examine the organisation, we find that it affords as clear and unbroken proofs of what has been stated, as if the body had been framed for the express purpose of demonstrating the truth of the mind's existence, immateriality, and consequent immortality. It could not indeed be otherwise: for, as the truth to be demonstrated by an appeal to the body is the existence of the mind and the adaptation of the body as an instrument for the use of that mind, it follows that every step of the examination must go either to the establishment of that truth, or to its overthrow. This being a case of nature, and not of human invention or contrivance, and nature being in every other case so perfectly consistent, that there never is any conflicting evidence to weigh, other than that which becomes apparently so from our ignorance, and to know being always perfectly synonymous with to believe, the evidence must all go one way in this case also; and a very slight examination may convince any one that the evidence of reason points to the very same conclusion to which revelation invites,—namely, that the principle of action in man is a principle not material, and therefore not liable to death or dissolution. Farther, that no bounds can be set to the quantity of knowledge which this principle is capable of acquiring; and that it is man's own fault, or his folly, if the acquisition does not go on accumulating, in a rapidly increasing progression, age after age. For, though past history shows that in former times there was a dotage of nations, as well as a manhood of intellectual strength, yet, independently of the fact that nations are always physically young, the same history affords evidence that the dotage which brought about the decay and ruin of the cultivated nations of antiquity, was the imbecility of a constitution wasted by disease, and not the effect of any natural decay. In proof of this, one may appeal to the state of modern Europe, and of all those parts of the world which modern Europe influences, and that is now the greater part of the habitable surface. During the last hundred years the nations of modern Europe have had at least their full complement of war, and those wars have certainly been more expensive, and probably more destructive of human life (that is, in proportion to the number of men actually killed, though certainly not in proportion to the numbers composing the nations between which these wars were carried on); but still, even in the hottest of the fight, the course of improvement was never stopped—not totally even at the very scenes of engagement. Nay, the necessities of the war may in many cases have been stimuli, and very powerful stimuli to improvement. Of this we may mention, as one instance, the contrivance by the French chemists to produce nitre from artificial beds in their own country, when the nation was so hemmed in that it could not procure a supply from foreign countries. This is but one instance, out of many, which will readily suggest themselves to every one who takes an interest in this most interesting question.

This view of human nature, according to which the really active part of it is elevated above the nature of material things, and not clogged, encumbered, or bent down, by the resistance of any of the common laws of matter, which restrain and limit the very instincts of all other animals, is calculated to raise high the hope and confidence of man, even, in this world. No doubt the body is subject to the laws of matter; and admirably as the body is constructed, that which man can achieve individually and with the naked hand is very limited—below what we would consider even tolerable subsistence in the most favoured spot upon earth. But the mental purpose and the mental plan are formed and fabricated independently not only of all the trammels of physical nature and its properties, but absolutely unbounded by space or by time. If we carry along with us this single principle, that we cannot in any thing which we attempt overcome a mechanical resistance or dissolve a chemical union, without the application of a power greater than that which resists in the one case, or holds in union in the other, we may not only plan, but absolutely carry into effect, whatever we purpose. The qualities of matter are so numerous too, and they have been disclosed under circumstances often so unlikely, that we can no more set bounds to what shall be discovered in nature than we can to what shall be devised by mind. If our forefathers, only a century and a half ago, had been told that the scientific use of a few bushels of coals and a few gallons of water, would increase the life of man sevenfold in useful duration, they would have deemed the teller fit only for Bedlam; but when we find that, every day, steam ships and steam carriages convey both men and merchandise, with at least seven times the rapidity that they were carried at that time, and also with much more certainty and comfort, we have the demonstration before our eyes, as a matter of daily observation, so common that we pass it over without a marvel, and almost without a thought. And it seems to be with the general progress of discovery and application in nations, as it is with the progress of knowledge in individual man: the more that is acquired, the room and facility for further acquisition become the greater. Nor is it difficult to see that such must be the case: for all true knowledge is of a fertile nature; and every portion of it that we acquire points out, smooths, and shortens the way to another portion.

In this again we have an irresistible proof that that which discovers, and knows, and points out how the discovery and the knowledge are to be applied, can have none of the properties of matter, and therefore cannot be material. The properties of matter are constant. It requires the same effort of strength to lift a pound weight, and the same degree of heat to smelt iron out of its ore at the present day, as it did when the inhabitant of Britain was a naked savage in the woods; and the men of the present time, by whom wonders, compared with what could then be accomplished, are performed with the greatest ease as matters of common every-day employment, are not a tittle stronger, and have not their senses any more acute than these rude people; but are rather the reverse, inasmuch as they depend more on the results of knowledge, and less on their individual bodily powers.

Now, if we consider this unchangeableness of the properties of matter, whether as inorganic, or as in the organised body, this conclusion forces itself upon us—that a material creature, how curiously soever it may be organised, could not, in the nature of things, improve one jot in one generation upon another. External circumstances it might obey, and be by them so far modified, as we find many animals modified by situation and climate; but of itself it could neither improve nor deteriorate, but would necessarily, under the same circumstances, remain, in all its qualities and all its habits, specifically the same creature from the beginning to the end of time. And, when we look abroad, and survey all living creatures, man excepted, in their present state, and in all of their past history of which any thing is recorded, we find that, in respect of improvement, they are as passive as the grass on the meadow or the rocks in the mountain. If circumstances more favourable to their subsistence come round, they multiply in numbers, and are proportionally in better condition; and if the circumstances are reversed, their numbers decline, and the individuals fall off. But those changes, whether in the one direction or in the other, are in exact proportion to the changes of circumstances; and therefore their causes must be wholly in those circumstances, and in no wise and to no extent in the creatures themselves. They bend to the wind of occurrences in the general system of material nature, just as the reed bends to the wind of heaven; but just as the reed, as long as it is a living plant, continues rooted in the earth, so do they continue rooted to those characters which stamp upon them their specific natures; and they can no more escape from or alter those circumstances than the reed can betake itself to a more sheltered spot when the hurricane threatens to tear it up by the roots. To resist the common laws of matter by contrivance—to battle with the elements, as it were, and to overcome—to improve by its own energy, and even, the converse, to deteriorate from the relaxation of that energy, cannot be predicated of matter under any imaginable circumstances; for that would not only be contrary to the whole tenor of what we know and can observe respecting matter, but it would necessarily lead to the conclusion that matter is self-existent; and this is the ultimate belief to which all scepticism as to the existence and immortality of mind in man directly tends; and sceptics who stop short of this have small merit in so doing, inasmuch as it is merely on account of their being too ignorant or too indolent for following out their own argument.

That the classing of man with the other animals, and treating only of the form, structure, and functions of the body in natural history, has some tendency to produce a leaning toward the doctrine of materialism, at least on the part of those who have merely a surface knowledge of the science, cannot be denied. But still much of the raving in which those who appear to exist, or, at all events, to write and publish, for little other imaginable purpose, is the result of mere prejudice, as ignorant as it is arrogant. In matters of speculative opinion which, however important they may be in themselves, do not involve the gaining or the losing of worldly property, men never seek to deceive others unless where they themselves are deceived; and wherever we find a person calling himself a naturalist, and professing sceptical or material doctrines, we need no further evidence to convince us that, whatever he may know of the mere details, he is not, in the more general, useful, and better sense of the term, a naturalist at all, but a mere impostor, though probably a self-deceived one, and therefore deserving pity rather than the exercise of any harsher or stronger feeling.

But still, though when one has made so much progress in the study of nature as to see how perfect it is in its design, how beautifully it works as a system, how true each part is to the laws which have been given it, and yet how readily all co-operate with each other in the support and maintenance of the whole, it is as absolutely impossible to be sceptical of the existence of the author of nature, as it is for a perfect eye to be open at bright noon-day, and not see: yet, in the progress towards this equally beautiful and delightful elevation, there are difficulties to be overcome, and dangers to be avoided; and against these it becomes necessary to put those who are seeking the truth upon their guard. This is more especially necessary in that general knowledge of nature which should form a part of the education of every individual who is so educated as to enjoy the world while performing his duties to society in it, and not to pass his days in dull and unreflecting routine, like a mere tool, than it is for those who study only one department of nature as a trade or profession. The moral and social duties of man depend so much upon the fundamental principle of belief on the points under notice, that if the study of natural history have no other use, as much of it as should suffice to afford demonstration of their truth, would still be among the most valuable subjects on which instruction could be given.

The danger of error lies in the impossibility of bringing the whole subject at once before the mind; and as it is not easy, if the known makes a due impression, to prevent speculation with regard to the unknown, contradictions are apt to appear, which farther instruction would completely explain away, but which remain and ripen into errors if that additional instruction is not given. When the mistakes happen upon points which are connected with material nature only, they are of less moment, as they affect only the intelligence of the parties, and not their moral habits; but still it is very desirable to avoid them even then, inasmuch as mere goodness, without intelligence, is at best but a feeble and even a frail virtue.

Feeling that the error of confounding man with the system of material nature is the grand error, which not only destroys the better part of the human character, but spoils the rest of nature to man's contemplation, we, as anxious to produce a work of popular as well as scientific usefulness, have taken occasion, in our notices of apes, beavers, and other animals, which have, in some parts at least of their economy, been frequently confounded with man, to point out in what the difference really consists; and now, in this article, or at least in one of similar import, where man is usually confounded with the animals, we have gone over some of the proofs of the existence of mind in man, which arise from the mere study of nature, and without reference to that which is revealed in the Scriptures, and which could not have been arrived at by any study of nature, however extensive or however accurate: otherwise revelation would not have been necessary.

We may, however, remark, in passing, that there is that correspondence between the evidence of nature and the evidence of revelation, which shows that they both emanate from the same source—that the God of Nature and the God of Grace is one and the same. In both, partial views are apt to lead to erroneous conclusions; so that, in order to arrive at the truth, we must study the whole revelation of God in his word as well as in his works; and if we do so, we are sure to find not only that each is perfect and conclusive in itself, but that the two are in perfect harmony with each other: with only this difference, that the law of God, as manifested in nature, is for all the creatures which he has made; while the law as revealed in his word is peculiarly and exclusively for man.

It is the omission of the consideration of man as having an immaterial and immortal spirit, in addition to the body, and the consideration of the latter only as part of natural history, which gives the reality or the appearance (for it is the appearance more frequently than the reality) of materialism to this branch of knowledge; this, therefore, is the view we have taken in the present article, the one in which man is more directly considered as part of the general system of animated nature, as the most proper one under which to show that, even in a natural history point of view, man cannot be regarded as a being wholly composed of matter, but that the material body is only the instrument by means of which the mental or immortal part acts. If the arguments, or rather the proofs (for when all the evidence tends one way there cannot, strictly speaking, be any argument) which we have adduced be properly considered, we feel confident that they will be found conclusive. We have endeavoured to express them in plain and simple language, without any of the technicalities which are usually employed upon such subjects, in order that they may be generally understood; and we have made them, in as far as possible, new, both in form and in substance, in order that they may be the more striking.

Viewing what man does, in opposition to what is done by the other animals, the sum of the whole argument for mind is—that man is the only living creature in the world in which there is a principle or capacity of self-improvement, by means of which one generation, availing itself of the experience of the generations which preceded it, can become better informed than they; or which, by failing to exercise the means by which this improvement is attainable, can deteriorate and fall off. That which is formed of matter, in what manner soever that matter may be organised, cannot have such a principle, unless we suppose that matter, in the case of man, is endowed with properties not only different from but absolutely contrary to those which it possesses, either generally, as inorganic matter, or peculiarly, in consequence of the particular organisation and instincts of any animal.

Those instincts are often very curious; and they are, in their operation, perfectly inexplicable to us, not only in those cases in which "an inferior degree of reason" has been inconsiderately ascribed to the animal, but even in those more simple instances which pass under our notice every day without in the slightest degree attracting our attention. That "the ox should know his owner, and the ass his master's crib," is just as wonderful as that the beaver should build a habitation against the winter, or the bee construct its cell so as to have the maximum of room and of strength out of the minimum of materials. The manners and habits of all creatures are useful subjects of study, not only because they are very curious in themselves, and evince purpose and design in the creation, which we can neither mistake nor refrain from admiring, but also because there is in each of them an example which we can always in so far imitate for our practical advantage. The latter must be the case: all the actions of animals, of what kind soever they may be, have for their object the counteracting or opposing of some of the properties or laws of inorganic matter; and as the natural actions of animals are all, upon the average, successful, it follows that they do, upon the average, overcome those properties and laws. Of the principles in which those instincts originate we do not understand, nor can we hope to understand, any thing, because we do not understand the principle upon which the most simple substance in nature possesses its most simple quality; but they all operate by means, and not by miracles; and those means are always open to our investigation. We cannot, for instance, say why one animal flies in the air, another swims in the water, and a third burrows in the earth; but we can always observe the organisation which it employs for that or for any other purpose; and, upon observing it carefully, we invariably find that the end is accomplished by means which are in perfect accordance with the principles of mechanics, as applied to inorganic matter. All the common external actions of animals are, indeed, strictly mechanical, or employed in the overcoming of mechanical resistances; and that is the reason why there is so much practical advantage in the study of them.

But though we cannot tell in what manner the instinctive impulse in the animal acts, or why one particular form of organisation, and one particular class of instincts should invariably accompany each other; yet the constancy of the latter accompaniment, to which in wild nature there is not one exception, at once shows the perfection of the system, and that that system is altogether one of material nature, varying in the instincts which it possesses, and in the actions and habits to which those instincts give rise, in exactly the same proportion as the organisation varies; so that—when we have once made ourselves duly acquainted with the relation between instinct or habit and organic structure—we are never at a loss in assigning to any species its proper place in the system, even although all that we know of it be merely one dead specimen fetched from the opposite side of the globe, about the habits of which the bringer can tell us nothing. But as the instinct and the habit of the organised being are thus constant to the organ, in the same manner as the mechanical and chemical properties of any piece of inorganic matter are constant to its mechanical size and consistency and its chemical constitution, we are warranted in concluding that the animal is nothing more than matter, deriving peculiar properties from a peculiar organisation, just as a chemical compound is nothing but matter, deriving peculiar properties from the peculiar number and proportions of its ingredients.

For some account of the rationale of taming animals, so as to make it appear to superficial observation that their instincts are altered, we must refer to the article Domestication; but we may here remark, that, as animals never tame themselves, nor those of the same species each other (for the use of tame elephants in the capture of wild ones, and some analogous cases, may be explained upon very different principles), and as mankind, taken as an entire race, must be self-educated,—taming and educating are not at all operations of the same kind. We may be said to tame not only vegetables, but inorganic matter, much in the same way, though not of course by the same means as we tame animals. Every cultivated field furnishes us with an example of the taming or domestication of plants; and the products of all the arts show us how inorganic, or, at all events, dead matter, may be tamed. The cases are not the same in their details, because the subjects operated upon are different, but the principle is in all the same: the subject is placed under new circumstances, and the result is a change in so far as the new circumstances are calculated to effect that which man wishes to alter in order to suit his purpose, but not any further. Thus taming, or domestication, is nothing more than a peculiar application of that which is learned from experience, either in simple observation or in experiment; and all that it proves is, that the creature which is domesticated is so far obedient to circumstances, and the right ones have been resorted to; but the change is no more brought about by anything in the creature itself than animals bring about of their own purpose or volition those changes of seasons which are accompanied by changes in their habits, and often in their appearance.

If the dead body of a human being, which bear upon it no marks by which the particular tribe to which it belonged, or of the mode of life which it had followed, were brought before all the naturalists in the world, they could not, by the most profound knowledge of the relation between structure and habit, which is so easily and clearly traceable in every other animal, come to the smallest conclusion as to what had been the habits of that human being when alive. The houseless tenant of the wild wood and the dweller in the most elaborately formed and luxuriant palace, the king and the beggar, the philosopher and the fool, the man adorned with every virtue and the villain stained by every crime, all become the same in death; or if there is any expression on the countenance of the dead body, it is rather that of the means of death than of the manner of life. Every one conversant with the subject knows that if the greatest hero falls by a gunshot wound which is instantly mortal, his features are as much relaxed and subdued as if he had died of fright; while death, produced by transfixing with a spear, will knit and stiffen the features of the veriest coward into an expression of heroism.

The organisation of man has, therefore, nothing farther of a positive nature to tell than that he is man; but the negative eloquence of its silence in other respects is most important as well as most impressive. It speaks of *the man*, the active, the reasoning, and therefore the accountable being, as the empty sepulchre does of the body which was laid therein—"He is not here;" and thus the very death of the body bears testimony to the immortality of the spirit.

We should now proceed to the structural part of the argument, that which shows, from the organisation of the human body, that that body is not in itself a perfect being, and that, without the operation of the mind, it could not maintain its place, or even exist in the world. But this article has already extended to a greater length than could have been wished; though the great importance of the subject, the most deeply interesting which can occupy the human powers, and one in which we are all equally interested, together with the novel mode in which it is treated, and the perfect originality, in so far as the author knows, of some of the arguments, may perhaps be admitted in excuse of an additional paragraph or two. If we omitted or passed slightly over this part of the subject, we should consider our duty to the public but ill performed by any mere account of animated nature, even if it emanated from ten times the knowledge, and were drawn up with ten times the ability, to which the writer of this article can have any pretension. We have often regretted, upon reading works on natural history, which were in every other respect worthy of our warmest admiration and gratitude, that they stopped short of or blinked this question, as if it formed no part of that very subject in the study of which it is almost the first question that arises to an inquiring mind. And when we have found material nature set forth with all the truth of philosophy, and all the fascination of eloquence, with the structure and functions of the human *body* among the rest, but without one allusion to the *immortal part* of man's compound nature, we have momentarily felt that thrill of dreadful and indescribable horror which "the dream of annihilation," how momentary soever may be its visit, never fails to inflict; and we have felt disposed to address our material instructors in language somewhat similar to that in which queen Katharine addresses the cardinals:—

> "Ye *turn me into nothing:* wo upon ye,
> And all such false professors!"

though there was no falsehood in the case, and no desire of concealing the truth, but merely the custom, which has most unwisely crept in, of treating of one of two subjects which are inseparably connected both in nature and in the ordinary course of human thought, and wholly omitting the other.

Besides the length to which it has already extended, there are some other reasons why the structural part of the inquiry should not be included in this article. The *anatomy* of the human body is a distinct science, and will be found treated of as largely as is necessary for popular purposes in the first division of this Cyclopædia; and, as there is no living action in man in which the mind is not concerned, the consideration of the organ can be much more usefully introduced along with its subservience to the mental physiology; and consequently all which remains farther to be said of man, as an object of natural history, can be more clearly as well as more briefly expressed in the article MAN, which the student may read as a sequel or accompaniment to what has been here stated.

BIRCH (*Betula*). A genus of forest trees, of which there are several species; and some of the species, or at least what are considered as species, are apt to run into varieties.

The common birch, *Betula alba*, is very abundant in the northern parts of Europe; and there are still extensive natural woods of it in many places of the highlands of Scotland: nor is it altogether unknown as an indigenous plant in the uplands of South Britain. It is, perhaps, the most hardy of all the forest trees, and the one which is found uppermost upon the mountains, and nearest to the pole—at least it is much more so than any other indigenous tree.

On the mountain-tops it is exceedingly small, and quite the miniature of a tree, with a stem not thicker than a quill, leaves not larger than those of duckweed on a pond, if indeed as large; and altogether not more than from half a foot to a foot in height. Still, however, even where it is most dwarfed it possesses the proper form of a tree, and does not run into a shrub, as on the moors of Sussex and other parts of the south of England.

No tree is, indeed, more liable to have its size altered by situation than the birch; and when it is so altered, all the parts of it may be said to alter in the same proportion. The leaves are small, and the twigs slender in proportion as the height and thickness of the trunk are less. It is only in very peculiar places of the Scottish mountains that the dwarf birch is met with in the full perfection of its littleness and tree-like habit. Those situations are high mountains, the summits of which present not cliffs, but terraces of mould; and the dwarf birches are met with on the southern exposure, a very little below the snow.

In the sheltered dells and bottoms, and especially by the banks of clear running streams, when these do not consist of bog or peat, but of patches of rich mould with rock interspersed, the birch becomes not an unstately tree, and it is certainly a very beautiful one. The bark, which on the specimens exposed to the blast of the hill is torn and broken by cracks and fissures, is, on the rich and sheltered ground, of a delicate white colour. The green, too, is exceedingly delicate, especially in the early part of the season; and scarcely any foliage can rival in tint that of a copse or grove of thriving birches at that season of the year. It has this further advantage, that the scent of birch leaves when they expand, and, indeed, up almost to the period when their vegetable action ceases, have a very fragrant and exceedingly refreshing scent. The tree is one of the sweet-juiced class, though the bark is astringent; and grass grows better under or in its shade, and suffers less by its drip, than in the case of almost any other tree.

The most beautiful habit of the tree is when its branches are slender and pendent, forming what is called a weeping birch. Authors sometimes state that the weeping birch is a different species from the common; but in the wild birch woods of the Highlands weeping birches occur so frequently on the richer grounds, and especially on the banks of the streams, and birches which do not weep, on the more barren exposed places, that it is scarcely possible they can be different species. In confirmation of their being the same, we may mention that it is a saying in some parts of the Highlands, that "The birch is a silly tree, for it weeps most where it has the least cause."

Birch.

On the banks of some of the larger rivers, just before they leave the mountains, birch trees often assume a very interesting character. The fibres of their roots clutch the projecting pieces of rock, as if they were the talons of birds of prey, penetrating downwards to a considerable depth. In effecting this the power of vegetable action within will sometimes open a crevice where the lightest stone it has to move is many tons, they thus draw a copious nourishment for the trees, as well as give them a firm support. In favourable exposures the height may be forty, fifty, or even sixty feet, though the trunk is rarely, indeed, so much as one foot in diameter.

In these situations the pendent or weeping twigs, seldom thicker than packthread, are often forty or fifty feet long, and wave most gracefully in the little winds which are sporting over the waters in those wild places.

The points of those twigs are often bathed in the pools, or they play in the waterfalls, and a cascade among rocky grounds, with weeping birches, is perhaps one of the most picturesque scenes, on a small scale, which the country affords.

It is difficult to say in which places of the Scottish Highlands, cascades and rapids, with their accompaniment of waving birches, are the finest; but the "Dream of Kilmorac" on the Beauly, the fall of Rogart on the Conan, some of the woods at Cawdor Castle, those by Inver Farigag, and other places by Loch Ness, and also many parts on the Dulnan, are worth visiting.

Among the rude Highlanders the birch is the principal tree for country purposes: fences, houses, carts, ploughs, and all sorts of implements are made of birch; and it used to be quite common to see at the fairs in Inverness scores of equipages fully equipped, in which the horses and their riders were the only portions not made of birch. The twigs of the tree are naturally very tough; but, when used as substitutes for cordage, or for leather in harness, they have great additional toughness given to them by peeling off the bark and twisting the wood till it separates into fibres. A birchen "withie," as it is called, thus made, is considerably stronger and far more durable than a hempen cord of the same diameter; and the people use these, not as substitutes for cordage and leather, but as substitutes for iron. The wheels of the old-fashioned carts which were used for country purposes, were small discs of wood, made fast to the ends of a wooden roller, attached to the under part of the frame by two loops of birchen withie, turned round in them, which was the means of rotatory motion in the wheels: the creaking was exceedingly disagreeable, and so loud as to be heard several miles off.

The timber of the birch is white, close, and easily worked, so that it answers well in articles of turnery; but it is generally only of small diameter, and when used flat, it is very apt to warp. It is also very perishable when exposed to alternations of weather in close air, though it stands well in fences and hurdles; it is also much used for hoops, and the smaller twigs for brooms, the demand for which is very considerable. In the early part of the season, when the sap is in the wood, a sweetish juice may be obtained by bleeding the trunk, and this juice, which has an agreeable taste, is sometimes made into a weak wine.

The native birch is very easily raised in the nursery, and is so hardy, that it will grow in almost any soil, though the richer parts of the moorlands are the best adapted for it.

There are many foreign species, the timber of some of which is highly coloured, and therefore more showy than that of the native tree. But these species are generally American; and American trees never yield so solid or so durable timber as European ones of the same genera. Some of their foliages have a deep colour, and therefore make a good variety in ornamental planting; and as the autumnal tints of American trees are remarkable both for their variety and their beauty, they are still more ornamental on these accounts. As timber trees, however, it is doubtful whether they are worthy of cultivation.

The bark of the birch tree is an article of domestic economy, both in the countries north of the Baltic and in America, where it attains a larger size than naturally in Britain. The bark is firm and durable, and it is made into boxes, cups, and various other containing vessels, by sewing it together. It is also the principal material of which the light canoes of the North American Indians and Canadian hunters are made; and those canoes are not only much lighter than our best constructed boats of the same burthen, but they are much stronger and scarcely less handsome.

BIRD (*Avis*, literally "that which flies," or in the plural *aves*, birds). A class of warm-blooded animals, and the second into which the vertebrated animals are arranged by most of the systematic naturalists.

Birds are a well-marked and easily distinguished class, even by their external characters; so that, though they differ much from each other in their appearances and habits, there is not the least danger of confounding them with any of the other classes. They are all produced from eggs, which are very generally, but not universally, hatched by the heat of the parent, which incubates, or sits upon them, warming them with the heat of the breast, which appears to increase for the purpose, and be one of the natural inducements for the bird to sit; and in many cases the breast of the female becomes denuded of great part of its usual covering, by which means the heat is more freely and immediately communicated to the eggs, the natural covering being a bad conductor of heat.

Though birds are not the only animals which are produced from eggs, and though the eggs of some species of reptiles resemble those of some birds both in size and in colour, yet the egg of a bird is very easily distinguished from that of any other animal. The shell is harder, containing more salts of lime and less gelatinous matter than that of the eggs of reptiles, and it is more granular in its surface; it is also more brittle, though from its shape it is strong in proportion to the quantity of matter in it. Farther, the egg of a bird cannot be dinted without a fracture of the shell, while that of almost every other oviparous animal may. The contents of the bird's egg are also chemically different from those of that of the reptile; indicating even in the rudimental state a higher degree of organisation, and along with it, as is always the case, greater energy and activity in the powers of life. The egg of the bird is much more albuminous, so that it "boils hard," while that of the reptile consists more of gelatine. The flesh of the animals has much the same difference of quality. The muscular parts of birds are more dry and rigid than those of even the mammalia; and some of them are so hard and tough, as not to be eatable. The tendons and even the membranes have the same proportional firmness of structure; so that the flesh of an eagle is much firmer than the flesh of a lion. Even the bones of birds partake of that firmness which is traceable in the egg. All those which are elongated and cylindrical are hollow; but there is no marrow in the tubes, and no part of them is cellular with merely a crust of solid bone on the outside, as is the case in many of the bones of the mammalia. They are all remarkably firm in their texture, and the shape of the bone is always such as to give the greatest possible degree both of strength and of stiffness with the least possible quantity of materials.

The distinctive characters which are traceable in the covering and contents of the egg, are found in an especially conspicuous manner in the covering of the bird. All birds are covered with feathers; and they are the only animals which, properly speaking, are so. These feathers are of two sorts,—feathers for clothing, to protect the animal from the vicissitudes of the weather, and feathers for flight. Both of these are beautifully modified so as to suit the different habits of the several species, and adapt them to the climates and the elements in which they find their food.

Some other animals, as for instance the lepidopterous insects—the butterflies and the moths—have a coat of feathers, or rather of fringed or feathery scales; but these have few or none of the characters of true feathers, and in no case, except that of birds, are feathers the instruments of flight. But still we can, in the imperfect feathers of the lepidoptera, discover one of the uses of feathers in birds better than we can perhaps do in the feathers of birds themselves, as in them it is conjoined with other uses. The study of one animal often assists us in acquiring a knowledge of another, especially when the one contains a single part of that which is a compound organ in another; because by this means we get an analysis of the living animal, which is far more satisfactory than any that we could obtain by the dissection of a dead one; for we can, in the one case, actually see the part of the organ in action, whereas in the other we can only infer or guess at the way in which it acts.

Now, every one must have noticed, that bees, flies, and all insects which have membranous or naked wings, must keep those wings constantly in rapid motion while they fly. The motion is often so rapid that the wings cannot be seen, any further than by a sort of tremulous motion in the air; and the action of the wings produces all that humming and buzzing among flying insects, which makes the summer air so lively; for insects do not breathe by the mouth, and have no organ of voice of any description. The action of those naked wings upon the air must be very considerable; because when a common blue-bottle fly (*musca vomitoria*) alights on the window, and marches along one of the dusty bars of the frame, winnowing the air with its wings, in a vain attempt to escape through the glass, it stirs the dust more in proportion than a coach and six driving rapidly along a dry road on a hot summer's day. Insects with wings of this description cannot *hover*, or lean on the air with still and expanded wing.

But the lepidoptera, especially the butterflies, do hover about, and rest on the air, and wheel in various directions, with very little apparent motion of the wings; and when they do move them, it is done much more slowly than the motion of the naked wing, in proportion to the rate of progressive motion. These lepidopterous wings also move in silence, or when they are brought into such rapid action as to produce a sort of noise, it is a low and muffled rustle, and does not ring out, so that the largest butterfly or moth gets along much more silently than the gnat. We may add, as a farther instance of the same kind, that the bats (see BAT for the particulars, and in that article will be found some of the points of difference between bats and birds), when they fly, are obliged to winnow the air with their flying membranes, something in the same way as naked winged insects, though the flight of bats, unless when they are agitated, is comparatively noiseless. So also those reptiles which fly by means of membranous appendages, are obliged to flutter these very much in proportion to the rate of their progressive motion.

Now the difference of action in these two textures of wings in the other classes of animals, shows us the advantages which birds derive from their feathery covering and feathery organs of flight. These feathers, even to the minutest fibre on the plumes or necks, are tubular, consisting of only a thin film of solid matter, filled with air within, though strengthened by partitions of cellular substance, more or less close together, according to the strain which the feathers have to bear. From the mode in which the feathers, and all their parts, are laid upon the bird, it presents a smooth surface upwards and forwards, so that the animal can move in either of these directions, with very little resistance from the friction of the air. When it moves in either of them, the resistance of friction does not increase so rapidly as the rate of motion; because the pressure smooths the feathers, and causes the air to take less hold on them. This property, which arises in part from the texture of the upper surface of the feathers, but chiefly from the way in which they are formed and placed, is of equal service to birds when they must perch, or otherwise remain at rest so as to abide the blast, as when they fly exposed to it. Perching or flying, when a bird is in the wind it always faces the current; and thus offers the least resistance both by its form and its feathers.

When, however, the feathers are taken in the opposite directions, they offer as much increase of resistance as they offer diminution when they are taken above or in front. The wings are always more or less hollow on the under sides, and they take hold on the air by millions of fibres; so that a bird with its flying feathers on the stretch, would fall much more slowly than one would suppose from the difference between its specific gravity and that of the air.

The resistance which all the feathers on the body of the bird offer to motion backwards is still greater; and it increases with the force which tends to move the animal in that direction. The instant that it begins to be so driven backwards as that a current against its body is produced, the points of the feathers rise, and take the wind with so many fibres that the resistance is very similar to that made by a scaly fish, when one attempts to draw one of these by the tail; and every one who has angled, and accidentally caught even a common trout in that way, knows that an ounce weight is as difficult to land when so hooked as a pound weight is when hooked by the head. But the feathers of birds rise much more in proportion than the free edges of the scales upon any fish; and they are every way as well formed for "holding on" in the air, as those are for holding on in the water. Thus the bird may be said to resist motion backwards in the air, by throwing out the point of each feather like the "fluke" of an anchor.

And all this curious complexity of structure is necessary for enabling the bird to perform those motions which, in the case of an "air-bird," or one which is much on the wing, and on it in all weathers, is absolutely necessary. We are so much in the habit of seeing birds fly, and they fly with such apparent ease, that we are apt to overlook the many mechanical difficulties that have to be overcome by their organisation. But when attempts have been made by men to construct flying apparatus, or even to accomplish the apparently much simpler object of directing a balloon, which floats buoyantly without any effort, because it is filled with gas specifically lighter than the atmosphere, the attempters, notwithstanding all their mechanical boasting, and even their mechanical science, have found that they would require to go a long time to school before they could accomplish even the most apparently simple of those objects. A flying apparatus, to be moved by the human arms, is, like the kindred fancy of a perpetual motion, a physical impossibility, and the attempt to construct one is one of those absurdities into which men are apt to fall in the infancy of knowledge, when they have vanity enough to lead them wrong, but want the requisite knowledge for keeping them right. Even if the arms could be trimmed to perfect wings, bearing the same proportion to the weight of the human body as those of the bird of most powerful flight have to its weight, there are not in the human body any muscles by which such wings could receive any thing like a flying motion. Then, if that difficulty could be got the better of (which it evidently could not), the spine would bend, the body cant over, and tumble to the ground on whatever part happened to be the heaviest. Or, if this again could be got the better of, man is not adapted for breathing on the wing, and thus the circulation would stop, and there would be an end of the flier in the very beginning of his flight. In short, it may be said without fear of contradiction that no addition to the human body could make man a flyer.

If the study of the structure of birds had no other effect than the preventing of such fancies as these—fancies which, like the other absurdity mentioned, still sometimes occupy time in which the schemer might do something not altogether useless—it would be worthy of our attention. The writer of this article remembers, long ago, a case in which a young man, in a small country town, had got so much of the formal or colloquial part of science, that he was looked upon as a prodigy, and, among other things, a very Archimedes in mechanics. Earth could not set bounds to his ambition, and he would needs fly: so, after months of labour, he produced a pair of wings, and, mounting the top of a high barn at his father's farm-yard, spread them for flight, and shot boldly into the air; but no shot pigeon, or even pig of lead, was ever more true to the perpendicular; and it was well for his bones that the cess pool of the farm-yard received him on its soft bosom; for the wings barely saved him, till he could be got out, from the triple death of being drowned, smothered, and "*sconfassed*" (that word is untranslatable) in the savoury compost. The consequence of this attempt at flight was not only the loss of all the high reputation which the party had previously enjoyed, but so overwhelming a burden of ridicule that it broke his spirit, and he became literally good for nothing while he lived.

The cases of all who attempt flying by mechanical contrivances may not be quite so disastrous as this one, but they must be all equally unsuccessful. Nor does it appear that the guiding of a balloon, in any other direction than that in which the current of the air happens to drive it, can be more successful. There is no fulcrum from which a purchase can be obtained but the air itself; and the air presses equally in all directions when still, and in the direction of the wind with a force proportional to the velocity of that when it blows.

Still the bird, when it flies, overcomes mechanical resistances, and, according to the general law of matter, it must overcome them by mechanical means. The bird, too, is very simple in its form, and certainly not more complicated in its organisation than the slowest-paced of the mammalia. But the bird, when its habit is to be much on the wing, is all-over adapted for flight, and the system of its mechanics, if we could fully comprehend it, would certainly be the most curious, and far from the least instructive, in the whole of the animal kingdom.

The buoyancy, as well as the upward motion, is not very difficult to understand, because the wing, from its general form, and the structure of the feathers, rises with much less effort than it descends. Thus the constant tendency of the powerfully-winged bird is to mount upwards, and on this account the firmest bird, that which with the same volume of body and extent of wings, has the greatest specific gravity, is the best flyer, flies more steadily, and apparently with less effort. This must, of course, have a limit; because, leaving the incapacity of breathing out of the question, no bird could fly in a vacuum, and thus there must be a certain density of air which is the best adapted for the flight of any given species of bird. This appears, even in the case of heavy birds, to be considerably less than the density of the mean level of the earth's surface. Eagles are heavy birds, even for their powerful wings, and yet they are high-fliers, even when their abodes are at great elevations in the mountains. All birds which take long flights fly high, whatever may be their other habits. Wild geese, herons, all birds indiscriminately "take the sky" when they set out upon long journeys. In some this may be in part done to avoid enemies or obstacles, but the habit is too general for being accounted for upon any principle save that the high flight is the less fatiguing. Even rooks may be observed to adjust the height of their daily excursions from the rookeries, to the distance at which the pasture upon which they are to feed lies; and the swallow tribe wheel about far more rapidly and gracefully when they hawk high before rain, than when they skim the surfaces of the pools in fine weather. If we may judge from their appearance when we see them on the wing (the only means we have of judging), it appears that birds, when they are not in search of any thing upon the ground near them, mount up till they come to that density of atmosphere which is best suited to their weight and wings, and then continue onwards. There may be another reason: those upper regions to which the birds ascend on their long flights are in a great measure exempted from the momentary gusts and squalls which war upon the surface under them.

This buoyancy, arising from the structure of the wings, is a very beautiful portion of the mechanics of birds, but it is one which man would find it very difficult to imitate. The general form of the wing, the characters of the feathers, the articulations of all the joints, the relative power of the muscles, and even the general form and action of the whole body, are concerned in it. They are all living too—all exerting their peculiar animal actions, in unbidden harmony, with each other; for even the feathers are alive, and the skin in which they are inserted can communicate an individual motion to each. Thus the process is one which we cannot analyse so as to bring it within the scope of our very limited notions of mechanics, though there is no doubt that both the compound motion, and all the individual motions, of which it is made up, are in strict accordance with mechanical principles.

The most singular part of the whole process of flying is, however, the ease with which the bird makes the air a fulcrum, from which to leap, in that same element, and that not only by repeated jerks or efforts, which are characteristic of many of the smaller birds, which thus leap from perch to perch, or from thicket to thicket, but in the case of steady onward flight, in which a few movements of the wings will sometimes send the bird onward for many yards without any other apparent movement; and such appears to be the impulse thus given, that the bird will sometimes turn, and almost double back upon its former course, by merely altering the inclination of the body and wings, and without any new stroke or effort on the part of these. The spring of the tiger, or the bound of the antelope, though taken from the solid earth as a fulcrum, and effected by what we consider as the most powerful muscular action among the mammalia, is a mere fraction in point of distance compared with some of these gliding rushes of birds in the air; and it is worthy of remark, that birds cannot take these motions when they rise directly from the ground, or from their perch, but must have a certain quantity of fluttering, or hurried wing motion, to bring them up to their power.

We know that when any thing is projected forwards the resistance from which it is projected must be equal to the projectile force; for no mechanical force can act in one particular direction only, unless by means of resistance in the opposite direction. Consequently, when a bird gives itself an impulse in the air, in which mere gravitation to the earth can bear no part, and that cannot bear a part, unless the direction is downwards, its body must strike the air backwards with a force equal to that which impels it forwards; and, if the body of the bird had not a means of resisting the reaction backwards, it might move its wings ever so long or so vigorously without advancing a single inch. That the bird derives the greater part of that hold on the air, which enables it to take as effective a leap from that element as it could from a solid substance, and even more so, directly by the action of the wings, is true; but there is no doubt that it receives considerable assistance from the general muscular action. When birds are on long and smooth flight, they also acquire a momentum in proportion to their velocity, and the difference between their specific gravity and that of the air. In consequence of this momentum, they continue their progressive motion with much less effort; and the superiority of this momentum, in a rarer atmosphere, may be an additional reason why they fly high upon their long journeys. But there are many birds which proceed by a succession of jerks or leaps, in the pauses of which they are almost or altogether at rest, and these birds can acquire but little momentum, but must renew their whole impulse at every jerk. These are, for the most part, birds of low flight; and it is probable that the greater resistance of the denser atmosphere is as advantageous to them as the rarity of the upper strata is to those species which fly with a momentum. Birds of smooth flight also, however, often shoot onward with great rapidity, after having hovered so long over the same spot, as that all the momentum which they acquired in arriving at that spot must be exhausted; and they must take the whole of their new velocities from the resistance of the air.

The flight of those birds which proceed by jerks affords a good illustration of the fact which has been stated, of there being a buoyant or upward tendency in the mere motion of the wings in flying. They do not proceed upon a level, but by a series of flat vertical parabolas, each as long as one of the jerks; and the motion is upward while the strength of the jerk lasts, and downward as it weakens. The tail feathers of such birds are also frequently flirted out horizontally, so that the tail may either resist too great an upward motion from the jerk, or act as a parachute against the downward motion.

The head and neck also come into action, both in altering the lateral course of the bird, and in shifting its centre of gravity, with reference to the central line of action in the wings; and the last alteration has no inconsiderable influence in its ascents and its descents. Indeed, a bird when flying is so much in action in all its parts, that it is impossible to point out the specific action of each. Thus we cannot explain the rationale of flight in any thing like a satisfactory manner, and therefore though the operation is not only possible, but performed habitually and with ease, the precise mode in which it is done still remains one of the wonders of nature.

We have made these general observations on the operation of flying and the organs of flight, not only because flying is peculiarly the motion of birds, and the one from which they are named, but also to show how much there is to be learned from operations of nature, which we all have daily opportunities of observing, and yet upon which comparatively few of us ever bestow a single thought. But it is not from this species of motion alone that we can obtain any thing like a knowledge of birds, neither can we found wholly or chiefly upon it that classification which is calculated to assist us in our inquiries.

The general definition of a bird, at least as dependent on its external appearance, is so simple and so well understood, that the repetition of it would be superfluous. It is a vertebrated animal; and, be the species what it might, no one would mistake it for one of the mammalia, or a reptile, or a fish. There have been some mistakes the other way, though they have been but few: in the infancy of natural science bats were considered as a sort of birds: and some of the moderns, who have not quite arrived at the years of scientific discretion in physiology, have gone about to make a sort of bird of the ornithorhynchus.

These mistakes show, what we find to be the fact when we make the attempt, that the natural, or even the satisfactory classification of birds according to an artificial system, is no easy matter. The bats were called birds on account of their flying membranes, and the ornithorhynchus because of its mandibles, which are something (but not very) like those of a duck's bill, while both animals had all the essential characters of true mammalia, though mammalia of peculiar form and habits. Thus it appears that neither the bill nor the flight of birds can be taken as the ground of a classification; as little can the feet; and the digestive organs merely point out the general kind of food, and not how or where it is obtained.

The feeding of birds cannot be made so good a means of general distinction as that of the mammalia, because many birds are so very miscellaneous in what they eat that no one article can be considered as their characteristic or leading food. And when we take the three leading characters: the bill and digestive organs as the system of nourishment, the wings as the organs of motion in the air, and the feet as organs of motion, we find that not even any two of them vary according to the same law, so that we cannot form a classification, even upon the relations which they bear to each other.

Thus, while birds are remarkably well defined as a class, while they are among the most interesting of all nature's productions, and while in their individual habits in wild nature, they are more accessible to our observation than, perhaps, any other animals, they are perfect puzzles when we attempt to systematise them; and almost the best that we can do is to go to wild nature, and study them individually in forest, field, or flood.

Their double motion, that of the feet and that of the wings, which is so modified that it becomes the four motions of walking, flying, swimming, and diving, is the chief cause of the perplexity. Some birds, as the common swift, have very little motion, save the aerial one; others, such as the ostrich, have none but the terrestrial one; some again, as the penguins, have very little more than the aquatic ones; and some, such as the pochard ducks, have all the four. Those which have the same kinds of motions have the one or the other predominating in an endless variety of degrees; and the character of the bill, according to the motions which we observe from other species, sometimes agrees more with the one system of nature, and sometimes with the other. All these perplexing circumstances increase the interest of the study of birds, at the same time that they increase the difficulty; and therefore, though none of the systems are quite consistent—that is, though no single character can be carried through the class—there has been no want of systems, or of ability in the formation of them. We have no desire to add another to the number, as the labour would be but of little value, and in this work out of place; so we shall chiefly follow that of Cuvier, though with some slight variations. The necessity which Cuvier, who had studied the structure of animals intimately, and endeavoured to arrange them according to it, found himself under of sometimes using the bills, sometimes the feet, and sometimes the wings, as the leading characters of his subdivisions, shows very forcibly the difficulty which attends this class of animals.

But before any system can be made intelligible to those who do not already understand the subject, we must give some explanation of the structures and functions on which the systematic arrangement is founded; and this will be rendered more easy of consultation by marking it off into portions under separate titles.

I. General characters of the class.—Birds consist of a head, neck, trunk, tail, and four limbs or extremities. The head is in general small in proportion to the whole animal; and the jaws are produced and terminate in horny mandibles, which open and shut horizontally, forming the bill, which, excepting in those species which kill prey, is the chief or the sole instrument in feeding. The bill varies much, both in the form and in the consistency of the mandibles. In some it serves as a pair of strong pincers for tearing flesh; in others it is a spear for transfixing; in others again it is adapted for hewing into timber; or it is fitted for boring into the ground or for dabbling in the sludge at the bottom of shallow waters, in which cases it is understood to have a sentient covering, so that it can both find and seize the food. Sometimes it is borne open as the bird flies, and catches insects as in a net; in other cases it catches by snapping. In some it is fitted for breaking the hard shells of fruits; in others for cleaving pulpy ones, or raising the scales of cones so as to get at the seeds. The modes of using it are indeed exceedingly varied; for birds are almost universal feeders, both in regard of substance and of situation; and wherever a bird's food is to be found, there is generally a bird to eat it, and the bill of that bird is always very well adapted for taking it. But the office of the bill ends with the prehension of the food, or the dividing of it into such portions as can pass the gullet (which is generally capable of considerable distension) into the stomach; and there is no mastication, or chewing by the mouth, of birds, and no apparatus for the performing of such an office.

The organs of smell, sight, and hearing, are placed in the head; the nostrils at the base of the bill, in the substance of it, or even near its extremity, according to the habit; and they are variously defended by feathers, hairs, scales, and valvular membranes.

The eyes of birds are placed in the sides of the head, generally speaking better adapted for seeing under them or laterally than above them or directly in front. But the position varies with the habit: birds which prey only in clear light and under them have the eyes far apart, and shaded; while those which prey in the twilight have them turned more to the front. The eye is better fortified than in the mammalia; the anterior part of the ball has a circle of bone; and there is a nictitating membrane, or third eyelid, which, when not used, is protected from the action of the weather by a lodgment in the inner canthus of the eye. It is thus more soft and moist than an exposed eyelid, and it works over the whole eye in a direction crosswise to the usual opening. The corner of the eye is very convex, and beautifully clear; but the crystalline lens is rather flat. The eyes of birds are in many instances much more exposed to the action of the weather than the eyes of most other vertebrated animals, and they appear to be the organs of sense upon which birds have their chief dependence; and, true to the general law of nature, that the supply is always proportionate to the want, they are furnished and fortified in an extraordinary manner.

The ears of birds, within the bones of the head, are well formed; but, with the exception of nocturnal feeders, which are, of course, much guided by the ear, they have little or no external concha. The nocturnal ones (the owls especially) have external ears; but the openings of the ears of all birds are concealed by feathers, generally of a more downy character than those on the neighbouring parts. These protect the ear from the violent action of the air when the bird is in rapid flight, and also preserve a uniform temperature in that delicate organ.

The neck of birds does not, like that of the mammalia, consist of the same number of vertebræ in all the species, but varies much according to the habit of the bird. In some it is very long, and in others moderate, but in all it is susceptible of much motion, and of motion in all directions; so that, generally speaking, the point of the bill commands the whole space within reach of the extended neck, and also all parts of the body of the bird. The vertebræ are also articulated in such a manner as that the greatest and most rapid flexures of the neck do not in the least disturb the spinal cord or the circulation in the blood-vessels. Neither does it, generally speaking, interrupt the breathing by the windpipe; though, as will be explained in another section of this article, the breathing of birds is not wholly performed through that organ.

As the bill of very many birds has to perform the functions both of a mouth and hand, it becomes necessary that the neck should be, in some respects, an arm; and it is a very convenient and efficient one. The extent to which it can bend, not only without injury to the bird, but with perfect ease, is proved by the fact, that most birds repose either with the neck doubled back upon the shoulders, and forward again on itself, or with the head placed under the wing. Many of the long-necked birds carry a fold of their necks upon their shoulders while they are in ordinary flight, though they stretch them out in case of alarm. The rapidity of motion, both in long necks and in those of moderate length, is exemplified in the strokes of the heron and the bittern, and in those of the woodpecker, which follow each other so fast, that the eye cannot see them, or the ear count their sounds. The rotatory motion of the joints of the neck is seen in the wryneck, which can turn the head quite round, till the chin and point of the bill are in the same line with the middle of the back.

The head and neck of birds, taken together, may, in the average of the class, be considered as the working apparatus, in the finding of food, the constructing of nests, and, generally speaking, in all mechanical operations. Their forms are of course as varied as the habits and haunts of the owners, being, in all cases, the best adapted to them; and therefore they do not admit of general description, though they are good characters of tribes and species, as indicating how and where the food is obtained. Independently altogether of their uses, in enabling us to obtain a rational knowledge of birds, they are valuable subjects of contemplation, as perfect models of mechanical arrangement, and most striking proofs of purpose, and the perfect accomplishment of purpose, in creation, which, labour as we may, will always present us much beyond our power of imitating, and may well command our admiration. And here we cannot help pausing to remark (for though the remark would occur to the reflective reader, we are unwilling that he should rob us of the pleasure of making it: as enough remains for him, and what we state may lead the unaccustomed to reflection)—how superior the models which we find in nature, are to those of human contrivance. We study the latter; we soon find out all their principles; and there, in so far as we are concerned, instruction, and with that mental pleasure, ends, so that, be it the steam engine, the chronometer, or any other *chef d'œuvre* of science and art combined, the mental improvement and pleasure are soon at an end; and we have nothing but the cold consideration of money value and utility, which, however necessary to our bodily existence and comfort, is always blight and mildew to the mind when uppermost there. Or, if we carry our observation further, we find faults and imperfections which we cannot remedy, and these spoil our enjoyment.

But when nature is the model, we find no fault or imperfection, and we never can exhaust the information which it affords. The Macedonian conqueror is said to have wept when the world was won; but if he had followed out the path of his tutor the Stagyrite, so far as to study the mechanism of the head and neck of a bird, he would have found, in that single specimen, a world of wisdom which he never could have conquered. There is not a projection or a hollow in all their curiously-shaped bones, or a tube, or membrane, or a fibre, in all the soft parts with which they are invested, but has its use, and is more beautifully adapted to that use, and fashioned with more perfect economy, than the most finished production of human skill. The motions which the point of the human finger can perform (see Articulata) are almost infinite to our arithmetic, but they are nothing compared to those of the point of the bill in some birds; and when we consider that, by the aid of its other mechanism, and without any apparatus but what God has given it in its own structure, it will strike prey under the birch in Lapland, and again perform the same feat under the palm by the bank of the Niger, before the same spot of earth has thrice seen the sun, it is passing wonderful, and should, even under the worst of the little casualties of life, make us grateful to God for giving us such things for our contemplation.

The body of birds, that is, the dorsal and the lumbar portion of the spine, upon which the body or trunk may be said to be articulated, has no specific action to perform in what may be termed the working motions. Hence, though it is composed of vertebræ, and by that means less liable to fracture than if it were a single bone of the same substance, the vertebræ admit of little motion, most of them are soldered together, and some of the junctions in time become ossified. It is the same with the sternum or principal bone on the under part. That is very large, and consists of five bones, which are closely united from the first, and ultimately soldered into one. One of these occupies the centre, two the sides anteriorly, and two posteriorly, the latter being forked at their posterior edges, though in some species the terminations of the forks are united by bone. The sternum in birds is a very important bone. One of its uses is to support the muscles which move the wings in flying; another to protect the contents of the body from injury or pressure from beneath, and a third to give support and firmness to them. From the number and importance of these uses, the sternum of birds is of no small value in the distinction of the different tribes; and on that account we shall have to revert to the notice of it in another section.

The furcal bone, or "merry-thought," formed by the union of the clavicles, and attached to the two projecting processes of the coracoid bones, keeps the shoulders apart from each other, and in their proper places during the powerful action of the wings in flight. The more powerful the flight of the bird, the more completely does this bone form an arch, so that it resists that compression which might otherwise take place in the throat and chest. Its form and strength vary much with the habits of the different tribes.

The bones of the pelvis advance considerably forwards; but they are open in the rear for the passage of the eggs. They and the bones of the rump are closely united together. The ribs, too, have very little motion, so that the operation of breathing alters the form and capacity of the body much less than in the mammalia. The greater part of the body may be regarded as a sort of box formed of bones, not breaking by slight pressure (as a box composed of one bone would be apt to do), but still very firm and stiff, stiffer anteriorly in those birds which fly much and powerfully, and more produced, particularly both in the sternum and the ribs, in birds which swim and dive. As a whole, it may be said to admit of no lateral bending; and the little that it admits of in the vertical direction is confined to the lumbar vertebræ.

The bony part of the tail of birds is generally short, the effective tail, as an organ of flight, being composed of feathers; but in all birds which have much motion of the tail, the number of vertebræ in that organ is considerable, though each individually is very short, and the whole tapers to a point.

The wings, or anterior extremities of birds, which correspond in position to the arms of man and the fore legs in the mammalia, are adapted for flight only, or, if they perform any other office, it is merely that of balancing. Their general action in flight has already been partially mentioned; their several parts, as they appear externally, will be mentioned in the next section; and their peculiar forms, as adapted to the different habits of the various tribes and genera, will be found in the accounts of these, under their respective names. We shall here only mention, therefore, that the bones of the moveable part of the wing consist of a humerus, a fore-arm, and a hand; the part answering to the fingers of the latter being very much elongated, with only one finger fully developed, but the rudiments of the other more or less apparent, according to the power of action in the wing. The flying feathers are placed upon these bones, and the thumb generally carries a little plume of stiff but short feathers, which is called the bastard wing, and in some species it is armed with a claw or spine. The head of the humerus is articulated nearly where the scapular bones, which are imbedded in the muscles on the shoulder, the coracoid bones which proceed from the anterior parts of the sternum, and the furcal bone, or united clavicles, which projects as an arch in front of the breast, protecting the vessels of the throat, at the same time that it keeps the heads of the coracoids and scapulars in their proper places, meet each other. The shoulder-joint, or articulation of the humerus, which is the centre of the grand action of the wing, is thus placed on the firmest of all supports—a tripod, which is the only number of supports that will form a sure base upon all kinds of surfaces. In birds of the most powerful wing, these three supports divide the space round the articulation into nearly three equal parts, and they do not differ much in strength; they all "give" a little, so that the joint is not nearly so liable to dislocation as if the point to which it is articulated were fixed; neither is there so much danger of fracture or of concussion to the vital parts by any sudden jerk given violently to the wing.

It is one of the most beautiful parts of the structure of animals, that those organs which have to perform the most violent motions are never directly articulated on an immoveable base, or a base immediately in contact with the spinal column, far less with the bones of the head. There is always the play of a slow-moving joint, or union of some description or other, between the articulation of the moveable bone and that bone which encloses the nervous mass. By this means that mass is made to ride smoothly while the animal leaps, or bounds, or flies, or otherwise acts powerfully and irregularly; just as the springs of a carriage enable those within it to ride smoothly, notwithstanding the jolting of the wheels upon an uneven road.

The scapula, or blade-bone, has less motion in birds than in mammalia, because, with the exception of those mammalia which have flying membranes, the motion of fore-legs is crosswise to that of wings. In the bat tribe there is a slight approximation to this species of insertion of the humerus in the large clavicles and blade-bones; though even in them the adaptation for an organ of flight is much less perfect than in birds. In bears, on the other hand, whose habit is to climb trees and otherwise to hug by the compression of the fore-legs together, the blade-bone is very moveable, and there are no clavicles.

Some of the birds which can fly, often use the half-expanded wings to assist in balancing them when they run; and this habit is most frequent with those that have the legs long. Some of the birds which cannot fly, have rudimental wings, which they appear to use for the same purposes. The only bird which has the wings so perfectly rudimental and concealed within the integuments as not to be of any use in balancing, is the Apteryx (see that article); and it has the legs very short and stout, and, though its habits are not known, it is probably not much of a runner.

Those short-winged birds which dive under water, whether they tread the water itself by means of webbed feet, as is the case with the diving ducks, and divers properly so called, or tread the bottoms of the shallows with feet that have the toes free, as is the case with the dipper, use the wings in the water. But wings are not very efficient instruments of progressive motion either on the ground or in the water, though they are of advantage in balancing on land, and in ascending or descending in the divers. All wings, whether perfect or imperfect, are formed and articulated on the same general plan; and though they admit of a little inclination to the front or the rear, their principal motions are always across the axis of the body.

From what was formerly said of wings acting more efficiently in an atmosphere rather rare than in a denser one, it follows that they must act still less efficiently in water than in the densest atmosphere. Indeed water is so nearly of the same specific gravity with the bird, that an action of the wings analogous to that of flying in the air, could not possibly be performed in the water. Air—the free air of heaven—is therefore the proper element for wings, and their proper function is flying; so that any other which they may perform must be regarded as a departure from the typical character of a bird, of which feathered wings are the grand external characteristic.

And here we may pause to remark on the wisdom of an arrangement which ensures a species of tenantry for the air, as beautiful as that of the most picturesque inhabitants of the earth. Clothed in a plumage no less durable than that of the most favoured of the animal kingdom, and performing, in their aërial flights, a series of gyrations ever varying both in form and character, to say nothing of their changeful and varied colours, which by the motion of the bird are made to rival the glowing tints of "the arch of heaven."

The posterior extremities, or feet, of birds, are their chief organs of progressive motion, and their chief supports when at rest, upon the ground or other solids. But the feet perform more operations than the wings. In some birds they are used for clutching or killing prey; in others for scraping in the ground for food, and also in the digging of burrows and the preparation of other places for the depositing of the eggs; in others, again, they are used as a sort of hands in climbing, in which operation they are in some species assisted by the bill; and in others still they are occasionally used in conveying the food to the mouth, or in holding it while it is preparing for swallowing, by the action of the bill. They are also varied to suit the kinds of surfaces which are frequented by the different tribes; and they serve as stilts for wading, and as paddles or oars for acting in the water. The general characters of the foot and leg of a bird are so well preserved through all their almost innumerable varieties of form, that there is no danger of mistaking them for the feet of any other class. The feet of some of the reptiles resemble them the most; but still the shape, the articulations, and the covering, even in the part of the bird which is not feathered, are all or each sufficient for distinguishing the one from the other.

The feet of birds are the organs of one of their most important motions; and thus they are made one of the grounds of that very imperfect classification which science has been enabled to make of the feathered race. As the bill is a sort of guide to the species of food; and the wings to the kind, style, and partially the purpose of flight; so the feet are a sort of guides to the home and habitation of the bird, and also to the place of its feeding, if its habit be not to feed on the wing; and whether that is its habit or not, can, in some degree, be determined by the characters of the wings and the bill. Birds which habitually feed on the wing have, in general, pointed wings, and can wheel and turn on the tips of them, whatever may be their other characters; and they have generally either a wide gape or a powerful and rapid action of the mandible, so as to catch their prey by snapping.

The leg and foot always consist of three principal pieces, independently of the toes: the femur or the thigh-bone, the tibia or leg-bone, and the tarsus or foot-bone. The tarsus, like the bones of the wings, answering to the palm of the hand, is always very much elongated; and it is popularly called the leg, though in fact it is the foot. Birds, in general, follow the same law as the mammalia in the use of their posterior extremities as organs of walking; they are digitigrade, or walk upon the toes, and not on the tarsus; and those which walk upon the latter have even a more awkward and shambling gait than the mammalia which have that habit; and indeed they can hardly be said to walk at all. The knee joint, or articulation of the tibia with the femur, which bends forward only, appears to be inadequate to the balancing even of a nearly inflexible spine in any but a nearly vertical position. In man we have a flexible spine, balanced with the whole length of the tarsus on the ground, but it is in an erect position; and besides there is the astragalus or heel-bone in man, which not only sustains the balance of the foot, but gives a lever power to the *tendo Achillis*, which, when pulled by the strong muscles to which it is attached, throws the pressure of the body upon the balls of the toes. The human foot is not, however, a fit subject of comparison with the feet either of birds or of the mammalia. See the articles BIMANA and MAN.

Those birds which bring the whole length of the tarsus to the ground when they walk, or attempt to walk, are but few in number; and they are all aquatic birds, the proper functions of whose feet is swimming and not walking. Their legs are articulated far backward, and they have that oblique motion of the joints for throwing the swimming feet at some distance from the body of which some notice will be found in the article BEAVER. They spend most of their time, and find the whole or nearly the whole of their food, in the water; and such of them as have not the power of flight (for some of them are so exclusively aquatic that they can neither fly in the air nor walk on the earth) deposit their eggs near the margin of the water, so that their terrestrial operations are limited to shuffling along a few feet, or sitting erect upon the rocks, in which latter, and even in the former, the tail assists in supporting them, as is the case with beavers when they stand up.

The head of the femur is articulated rather farther forward in walking birds than in the mammalia; and the femur itself is not so free or so much used in the motion of the leg. The tibia, or true leg, is the part usually called the thigh, or in the larger birds, which are brought to table, the drum-stick. In birds which make much use of their feet, the tibia is much loaded with muscles; and it is generally protected by a profusion of soft and downy feathers, especially in those birds which are much exposed to the weather, and use their toes in clutching or killing their prey.

Many of the wading birds, and some of the running ones, have a portion of the under end of the tibia bare of feathers; but the muscles do not descend so low as that part; and it may be considered as a general arrangement in the structure of birds that the muscles are always under a protecting covering of feathers.

The tarsi and toes, and also the naked portions of the tibia, contain few or no muscles, but are made up of bones, tendons, straps of ligaments for keeping the tendons in their places, and the integuments, which are very firm and tough skin, variously covered with scales, sometimes imbricated and sometimes reticulated; and there are often pads on the under part of a consistency not very unlike caoutchouc, or Indian rubber, and nearly as elastic and as difficult to wet as that substance.

The toes on the foot, three before and one behind, may be regarded as the normal number in the order; but they are fewer in some of the running birds, and more numerous in some of the other orders. The toes, however, vary so much in the manner of their articulation, in their size and power, and in their appendages, that they do not admit of general description. The toes are the portion of the foot usually taken as the ground of systematic arrangement; though as the principal muscles which move the toes are not in the toes themselves, or even in the tarsus, the whole leg would be a better indication of the habits of the bird; though, being a more complicated structure, an arrangement founded upon it would make the elements of the system apparently a little more difficult. But the difficulty would be apparent and not real; and it is very probable that, if we included a little more character, and thereby gave a little more meaning, to our larger divisions of the several classes of animals, we would both shorten and smooth the road to that accurate knowledge of the individuals, which is the valuable, and indeed the only valuable, part of the whole. The other method, that which takes but one portion of an organ as the ground of resemblance, is simple only in proportion as it teaches little, and simplest of all when it teaches nothing. See the section on SYSTEMATIC ARRANGEMENT in this article; and also the general article CLASSIFICATION in its place in the alphabet.

In all birds, the bending of the tibial and tarsal joints has the same effect in the contracting of the muscles which close the toes. This may be seen in those birds which draw up one of their feet, either to warm it, or to rest on the other; for the toes of the foot which is drawn up are always clutched together, and to open them out with the foot in that position requires an effort. It even requires an effort in the bird to keep the toes expanded. When it rests its weight on the feet the weight causes the effort; but the toes of a dead bird are always partially closed, which shows that a muscular exertion is necessary for keeping them open when that is not effected by the weight. When the bird is dead, the muscles, which act both ways, are of course equally rigid, and the toes close, to the degree at which the living muscles would balance each other, and the leg be in a state of repose.

This tendency of the foot to close when the leg is bent is effected in a very simple manner: the tendons of the contracting muscles pass over the outsides of the bent joints, and those of the extending ones over the insides; so that, by the bending, the former are pulled much in the same way as if their muscles were contracted and the latter are slackened in the same way as if their muscles were relaxed.

All feet which bear on the ground with jointed toes, and partially even those which have hoofs, possess this property, though few of them possess it in the same perfection as the feet of birds.

And when we consider the difference of habit between clutching, climbing, and perching birds, and quadrupeds which have actions somewhat similar, we can at once see that this property is most necessary in the feet of the birds. Mammalia which clutch prey with their paws have a point of rest for their other feet, either on the body of the prey, or on some other solid substance; and even in those climbing mammalia which are the most dexterous leapers, the spring is taken from the hind feet, and the grand use of the fore ones is to catch hold at the end of the leap. In slower climbers the one set of extremities are always fast while the others are extended; and in the few mammalia (such for instance as the sloths) which may be said to perch, the proper perching apparatus is hooks so formed by the claws and toes that the requisite shape is preserved by stops of bone. Thus, as the flexible spine of the mammalia requires to be borne up by two sets of supports, when it is in a horizontal position, so when they are in action they may be said to have always two points of support upon the ground or other surface which bears them up, a fore and hind one, of the opposite sides, alternately, when they walk; and the two fore and the two hind ones alternately when they bound and leap. The former of these actions is confined almost exclusively to the legs and feet, but in the latter the spine comes more efficiently into play, as may be seen in the leaping of the cat tribe or in the coursing of a greyhound.

Birds deriving no support upon solid surfaces from their anterior extremities, and having no action of the spine to assist them in leaping, and yet having to perch, and not only poise themselves, but find food, construct nests, and perform other operations upon perches far more unstable than any upon which the mammalia have to rest, must be more sure-footed in proportion. The slender sprays of trees, the flexible stalks of herbaceous plants, and all sorts of substances, not only of a yielding nature in themselves, but exposed to the violent action of the winds, by which both perch and percher are rocked at no moderate rate, are all pathways to one race or other of the feathered tribe. Nor, though at first sight such seems to be the case, is that the footing most difficult to be maintained; for, upon a bending twig or stem, the perch and percher soon acquire the same momentum, swing together, and have no more tendency to separate than water has to escape from a glass, when that glass is set in one side of a hoop, and the hoop whirled rapidly round on the opposite point. This concert of motion, as we may call it, is general in mechanics, and the application of it is of great service to all birds which feed or repose on perches of the description alluded to. It is the resistance of the bottom and sides of the glass to the centrifugal force of the water, and the resistance of the hoop to the same force in the glass, which keeps these three together, or in concerted motion; and in like manner when a bird is rocked in the spray, all that it has to do is to resist its own centrifugal force by the clutch of the feet.

But when the bird has to perch on the pinnacles of the rocks, as is the case with the mountain eagles and some of the other mountaineers, and also with several of the more predatory and powerfully-winged sea-birds, it has not the advantage of concerted motion along with its perch, but must either abide at rest, despise the tempest, or drift before its fury. The habitations of those species which sit on the pinnacles of rocks are the very homes of the tempests; for winds war upon rifted shores and among rugged mountains when the expanse of the sea and the plain are still. Not only this, but these birds live much upon the havoc which the tempests produce among other creatures; and thus it becomes necessary that they should be enabled to remain on their watch-towers, and mark its progress. But here, as in all other cases, the purpose of nature is accomplished, and accomplished by apparatus the most effective, and at the same time the most simple.

It is chiefly by the pulling of the tendons which close the toes, by the mere action of bending the joints of the leg, that this firmness on the perch is maintained. Their tendons pull all the phalanges of the toes; and thus the same action, and that not a muscular exertion, which would tire, but a state of greater repose than when the legs are not bent, enables the bird to hold on with the whole foot, and the hold taken by the elastic pads and tubercles is far more firm upon a hard substance than if it were taken by means of claws. The rock perchers also, in general, use their claws in clutching and killing their prey, so that they could not be used in keeping the perch without blunting their points, and thus unfitting them for their proper purposes; neither could a hold merely by means of the claws be kept for any length of time, unless the hold were above the body, and kept by the pressure of that. All perchers by the claws for repose perch with the back undermost, or at least in such a way as that the weight hangs upon the claws as upon hooks, the form of which is maintained either by stops of bone, or by the weight of the dependent body pulling the tendons, and the firmness is given wholly by the latter.

Those provisions for the secure maintenance of their place, in animals, arising from structure merely, and not requiring any muscular exertion, or other effort on their part, which can in any way fatigue them by its continuance, are among the most striking instances of that superiority of design and adaptation of which every thing that nature produces is an example. We know, from our own case, that if even a single muscle of the system, except those which are employed in immediately carrying on the vital functions, be exerted, not one part of the body, far less the whole of it, can be in that state of repose which is necessary for enabling the active system to recover its tone. With us, an easy position on the couch, in the chair, on the grassy sod, or on the bare earth, according to the habit, and the need that there is for rest, is the position for repose; and if we were to attempt to sleep, clinging by the hands, or in any other way in which our mere weight is not the means by which we retain our position, we should assuredly fall. But birds have to repose in all varieties of situation, and their means of keeping their places are increased and varied accordingly.

In their alimentary system birds are variously formed, according to the general nature of their food. If that food is wholly animal, their stomachs are simple and membranous, and their intestinal canals short, and without cæca. If wholly vegetable, the stomach is more complicated: one part, which is styled the craw, and which is little else than an enlargement of the inferior part of the gullet, being a sort of receptacle into which they can take much more food than the bare stomach can at once receive for the purpose of digestion. In this respect it bears some resemblance to the paunch, or first stomach of the ruminant mammalia; but as birds have no chewing apparatus in the mouth, the food taken into the craw does not return to the mouth, but proceeds into the stomach portion by portion, as the progress of digestion requires. The craw of these birds is generally placed in front of the sternal bones, so that it can admit of distension by a large quantity of food without disturbing the other viscera, or requiring any enlargement of the bony cavity of the body to admit of its distension. Even this position of the craw, which at first seems a very simple matter, is attended with considerable advantage to the bird. The habits of birds require that the size of their body should be as small as possible, and that the capacity of it, as determined by the bones of the trunk, should be as uniformly the same as possible. Now, if this craw, which, as a magazine of food, is sometimes empty and sometimes much distended, were lodged within the bones, it would either press in an inconvenient manner upon the other viscera, when full, or it would leave a vacant space in the cavity of the body when empty. Either of these would be attended with inconvenience, as the pressure on the viscera would disturb the functions, and render the bird inactive, and the additional space would require an enlargement in the cross section, and thus cause the bird to oppose more resistance to the air in proportion to its power of flying, and thereby to the same extent diminish that power.

The avoiding of the same inconveniences requires the existence both of the craw and the true digestive stomach as separate organs. Vegetable food contains much less animal nourishment than animal food, and in many birds there has to be as much and as severe labour used in the procuring of it. The waste of substance, and the necessity of food, is in all animals in proportion to their activity; therefore active vegetable-feeding birds must take a proportionably greater quantity of food than animal feeders of the same activity. This is well exemplified in the case of pigeons, and also in that of all the finch tribe which are active birds, and also very vegetable in their feeding.

If this excess of food were taken into the stomach at once, and that stomach lodged within the cavity of the body, the same inconveniences would arise as if the craw were situated there; and the stomach itself, as containing a greater quantity at once, would either require to be more powerful, or it would perform the function of digestion less efficiently. But, with the addition of the craw as a reservoir, the gizzard, or muscular stomach, which may be said to perform the operations of both mastication and digestion, can afford to be smaller; and this, besides making the organ more efficient, with the same exertion of muscular energy, leaves room for the greater length of the intestinal canal, and for the cæcal appendages which are necessary in extracting the chyle from the vegetable aliment.

Thus we see that, in the structure of the alimentary system in these birds, there is the same evidence of wisdom of purpose, and perfection of execution, as in that of their external organs. These advantages are not confined to the mere convenience of that system in which they are found. The advantage goes to all the habits of the bird. In birds, as well as in mammalia, the vegetable feeders are the chief prey of the carnivorous ones, and thus they require to be on the alert, and capable of making their escape at all times when their enemies are abroad. But if they took into the true stomach, and had subjected to the process of digestion at once the great quantity of food which is required for their support, they would, as in the case with birds of prey, be incapable of flight, or, at all events, indisposed to it, after a hearty meal. Their food they must take during the day, and not after dusk, and yet it seems that they require the digestive process to be going on constantly; and thus the moderately-sized gizzard, and the supply in the craw, are remarkably well adapted to their habits; so that, after taking an abundant supply of food, they are nearly as fit for flight as when they are empty.

The carnivorous birds, especially vultures, and other species which feed upon the carcases of the larger animals, when these are killed by other casualties, are remarkable for the opposite structure of the alimentary system, and for indolence after a full meal. Their stomachs are membranous and simple, and their intestines short, and without any cæcal appendages, so that the process of digestion is with them a much more simple matter. But when they have made a hearty meal, the full stomach presses upon and retards the action of the other parts of their viscera, or, at all events, the process of digestion monopolises the whole of their energy; so that, though birds of long and powerful flight when hungry, they are so reluctant to take the wing after feeding, that they may be knocked down with a stick, or taken with the hands, without making much resistance.

Their power of enduring hunger seems to be in proportion to that of taking food directly into the stomach, and converting it into nourishment by a more simple apparatus; and, unless when they are forced from their retreats by hunger, they are far more retired and quiet than the vegetable feeders. The same analogy holds between the carnivorous and the herbivorous mammalia,—the former come abroad only at particular times, the latter are habitually upon their pastures, and their hunger begins when the receiving stomach is empty, or nearly so.

Birds which are exclusively vegetable in their feeding, and those which are exclusively carnivorous, may be regarded as the extremes of the class, in so far as the alimentary system is concerned. The former have that system largest, most complicated, and most constantly in action, and the true stomach always a gizzard. The latter have, in proportion to the general size of their bodies, the alimentary apparatus smallest, and also the most simple, acting readily, but acting, or requiring to act, only at intervals; and they have the stomach always membranous.

Those vegetable feeders that live much on seeds and in temperate climates which is the case with the majority, require an auxiliary to even the muscular action of the most powerful gizzard, in order so to grind and divide the food as that the gastric juice can act upon it. For this purpose they swallow small stones and gravel; and it has been observed that some of the gallinaceous birds were kept in equal condition and in better health upon much less food when they had access to those auxiliaries. It is not improbable that a small quantity of resisting matter may help the digestion of all stomachs; and that it is upon this principle that brown bread is more digestive by the human stomach than bread of the finest flour from which the whole of the husky matter is separated.

Intermediate between those two extreme forms of the digestive system in birds, there are many modifications, adapted to all varieties of food. Some of them have the stomach more membranous toward the one extremity, and more muscular toward the other; in some the character of the stomach is partially changed by long continuance on a different kind of food; and it is by no means improbable that, in some of those species which live in great part upon insects at one season of the year, and chiefly upon vegetable substances at another, the stomach may undergo seasonal changes.

In proportion as any animal, whether bird or not, is more vegetable in its feeding, its abdomen, in a natural and healthy state, is always the more bulky in proportion to the whole body. This is very conspicuous in the mammalia, (in which the size and distinctions are more easily seen,) in which all the grazing tribes are full, and all the carnivorous ones lank in the belly; but it holds also in birds, though in them it is less conspicuous, as the whole body is covered with feathers, and the several parts are not so easily distinguished from each other. If, however, we attend carefully to the outline of their forms, we may, in most cases, discover a greater uniformity of thickness throughout in the vegetable feeders. This appears not only in the larger birds, in which the difference of other habits may be supposed to have some effect, but even in the small birds.

Generally speaking, too, vegetable feeding birds are not so well winged as those which feed upon animal matters. All the gallinaceous birds are heavy, comparatively bad fliers, and take only very low and short flights; while the birds of prey are among the most powerful fliers in the whole class; though even these are perhaps not so constantly on the wing, or so very long flighted, as some of the tribes which feed chiefly upon insects. In accordance with this formation, the vegetable feeders are not so regularly migratory. Some of them, indeed, change their abodes to considerable distances within the same countries; but they do not so frequently cross the seas, or range so far in latitude in their migrations.

The vegetable feeders and the animal feeders, among the mammalia and birds, agree with each other in the feeding in the two races, and differ from each other in the different feeders of the same race, in other respects. The vegetable feeders are, in almost all the genera, more or less gregarious, both in the one class and in the other; and when they migrate, they generally migrate in flocks, often in flocks containing immense numbers. The passenger pigeons of America, and also some of those which migrate seasonally in the longitudes of the east side of New Holland, New Guinea, and the Molucca islands, appear in numbers far exceeding those of any migrant birds of other regions or other species; and some of those which belong to the latter migration are as gay in their plumage as the parrots, or any other of the finest birds of warm climates. The males are also more polygamous among the vegetable feeders; and it is among them chiefly that they fight battles of gallantry, though many of the omnivorous ones agree with them in these, and also in some other of their characters.

That increased energy of character, which more or less affects all birds in the pairing season, appears to affect the different feeders in a different manner. Their breeding plumages are much more gay, as compared with the ordinary dress throughout the year, and the naked skin upon the head blooms into more brilliant hues. The eagles and hawks, which are the most carnivorous of the whole race, show the least change, either in colours or in manner, at that season; but the vultures, in which there is a slight approximation to the gallinaceous character, and a more decided one to the omnivorous, show a little more seasonal change; and, though race after race is constantly breaking in and destroying the regularity of the gradation, there is an increase of change till we come to those families which may be said to bloom and fade yearly, something after the manner of plants.

It is these breakings in of one tribe of birds upon the characters of another, which makes the systematic arrangement of this class of animals so uncertain and difficult; and the more that we study them, nay, the more intimately and accurately that we become acquainted with them, the less hope have we that any future knowledge can remove the difficulties. The four systems of the food, and the three habitats—air, land, and water, present themselves in such varied combinations and proportions, that the conclusion which we might very fairly draw from one character is barred by an opposite one, which follows as naturally from another; so that we cannot have a chapter of the inductive results of our observation of birds without an appendix of exceptions of still greater length.

But, though we must receive it with exceptions and limitations, there is still observable in birds, according as they depart in their general characters from the rapacious ones, an increase of seasonal change, connected with that energy, which is awakened at the pairing time; and though the individual characters of this change vary exceedingly, there are two great and not very badly marked divisions of it, the one taking place in those birds which are more vegetable in their feeding, and the other in those that feed more upon insects. In the former, it displays itself in greater brilliancy of plumage, and more intensity of action generally, especially in the male birds; under the latter it displays itself more in change of place. Not a little of the character of birds, both in themselves, and also as they are by analogy (which they are largely and accurately), indices to the rest of nature, might be worked out upon this principle; but, even though the length of this article did not threaten to exceed all wonted bounds, in treating on the same subject, this is not exactly the place for it. We still want the elements, in the accounts of the modifications of character by the feet and the wings, and also of the bill, as the grand prehensile organ in the feeding system; and therefore we must defer the general conclusions till we come to the articles on Change of Plumage, Migration, and Pairing. We shall therefore only further remark, in passing, that much of the character of the different tribes depends on the varied development of this seasonal energy; and that the character thus produced is much modified, according as the energy is more marked off in the locality which the bird inhabits when it is at first exerted, or prompts it to migration to a distant region.

The systems of circulation and respiration, in birds as in other animals, are closely connected, though not so much so as in the mammalia. The circulation in both is performed by means of a double heart, consisting of two ventricles for propelling the blood, and two auricles for receiving that fluid on its return; and connected with these, as in all animals that have the heart double, there are two sets both of arteries and of veins,—a pulmonary set and a systematic one. The circulation is, as has been hinted already, more rapid in birds than in the mammalia, which agrees with the greater violence and longer continuance of some of their actions. But though these more violent actions,—such as coursing on two feet as fleetly as antelopes do on four and with the aid of the flexible spine and its muscles, as in the ostrich, plunging into the water like the gannet or the cormorant, dashing through that element like the divers, cleaving the air beyond comparison with all terrestrial speed, as in the plovers, the swift, or the pratincole, or breasting the tempest with the majesty of the eagle, require, and are furnished with a supply of blood, proportional to the waste which their great energy must occasion; yet they are by no means so well suited to an equally rapid breathing by means of lungs. But the application of renovating air to the blood must, in all animals, be proportional to the circulation; and, among vertebrated animals, it is only the reptiles and fishes which have the temperature low and the circulation lagging, and which spend much of their time in a state of comparative inaction, that can carry on their systems in a healthy state with only a partial aeration of the blood.

If the subject is considered according to our plans in contriving and executing, there is thus a difficulty to be overcome in the case of the birds, similar to which nothing occurs in that of any of the other vertebrated animals. They stand more in need of the action of the air than any other animals; and their habits are such that they are less able to bear even the same action, by means of the ordinary apparatus of lungs.

Now this is one of those difficulties which human wisdom could never see the means of overcoming, except in the accomplishment of the very object, the means of accomplishing which are the subject of inquiry; and therefore it is wholly above the reach of the human powers, and in itself a perfect demonstration that the works of creation must have originated from One omniscient in knowledge, as well as omnipotent in action. But though in this, as in all other cases, we could never have fathomed the purpose of the Eternal, without the example which he has set, yet the lesson held forth in that example is, when scanned with even a moderate degree of attention (a degree of which any human being is competent), is so plain and simple, that a child may understand it. It is the same with all nature; and if the vain affectation of superior wisdom on the part of those who have attempted to school us in it, had not encumbered and concealed it by the clouds and darkness of words and wayward theories, the learned and the unlearned might read this, the elder and more general volume of "The book of the living God," together, and with nearly the same pleasure and the same profit.

And the means by which the action of the air on the blood of birds is rendered equal to the rapidity in circulation, and consequent necessity of vital repair, in that fluid, without the painful fatigue of ever-panting lungs, is made, like all other contrivances in nature, to answer other important purposes at the same time. The lungs of birds are ample in their dimensions, and have the cells into which air is admitted larger than in the mammalia; and they are kept in their places by being fastened to the bones. Ramifications extend from them in tubes and cells through the whole cavity of the body, into the hollows of the bones, and in short, along the course of every artery which is not immediately imbedded in those muscles, which are in action during the violent exertions of the bird. The blood-vessels in these muscles are fewer than those in the muscles of the mammalia, as any one may infer from the greater rigidity of their texture, and the whiteness of their colour. Thus, there is not a blood-vessel of any considerable size in the whole body of a bird, to the coats of which the air has not access during the greater part of their course; and thus the real action of breathing in birds is not concentrated into one organ, to be toiling and panting there, as it would be in the lungs of the mammalia, but distributed over the whole circulation, and consequently diminished in local intensity, in proportion as it is extended over a greater surface.

This is a subject which it is impossible to bring to the test of numbers, so as to compare accurately the diminution of local action by means of the general access of air to the blood-vessels. There are two difficulties, neither of which can be, from the great nicety of observation which they would require, overcome. In the first place, we know not, and we cannot ascertain, the relative surfaces of the blood-vessels exposed to the air in lungs only, and in the whole system, as in birds; and, in the second place, we know not the difference of action which the air may have on the coat of a very small blood-vessel, such as those in the lungs, and that of a larger one. We do know that the exposed surface of the vessels in the lungs must form but a small portion of that of the whole vessels in the system, because in the freest breathers, that is, what is usually styled the "longest winded" of the mammalia, which have their blood aerated in the lungs only, or chiefly, the portion which passes through these organs at each respiration of the breath, is only a small fraction of the whole. We know also that the coats of the larger blood-vessels must, in order that the vascular system may have equal strength in all its parts, have their coats much thicker and firmer than the smaller ones, though we cannot precisely say in what proportion; neither do we know to what extent the difference of thickness in the coats of the vessels diminishes the action of the air upon the contained fluid. Perhaps the thickness of the coats is directly, and the action of the air inversely, in some such ratio as that of the squares of the diameters of the different vessels; but this is a mere theoretic guess, undemonstrated, and incapable of demonstration.

Analogy shows, however, that the advantages which birds derive from this general admission of air to the blood-vessels is very great. The race-horse is quite fatigued with a few miles at his full speed, and so is the greyhound, while the lion himself is in need of repose after a single leap. But birds can maintain their rapid flight during the livelong day, and for hundreds of miles upon the stretch; and when they do, as is sometimes the case, drop down in agitation or in exhaustion, the former seems generally to be the effect of fear, and the latter of muscular fatigue, for they do not pant as the mammalia do when they have over-exerted themselves.

But the advantage in the aeration of the blood is not the only one which birds derive from this peculiarity of their structure. The same air which exerts its renovating influence upon the blood, supports all the more delicate structures which it reaches and surrounds, as a cushion of the most perfect softness and elasticity; so that, by the most rapid motion, and the most violent twitches which the body receives in the changes and turnings of that motion, there can be no concussion of the parts more immediately necessary for the life of the bird.

We should now proceed to consider the productive system in birds, the progress of the egg, the processes of nidification and incubation, and the attention of the parent birds to their young; but the egg itself can be more advantageously noticed in comparison with the eggs of other animals; and the principles of nest-making require a knowledge of the haunts and habits of birds, as well as of their vital functions. The one part of the subject can, therefore, be better explained in the article Ovipari, and the other in the article Nest. We shall, therefore, here close this section, the various topics involved in which no explanation could exhaust; and of which we take leave with feelings of regret, as one of the most interesting and fascinating with which the student of nature can be occupied.

II. External Parts of a Bird. The subjects to be noticed in this section are much less interesting and instructive than those slightly glanced at in the former one; but as the descriptions of all birds are founded chiefly upon the colours of the external parts, and as these are all that we know about those species which belong to science only as museum specimens, this part of the subject becomes necessary in a general article descriptive of the class. Its minor importance will, however, enable us to treat it more briefly.

The external parts of birds, as they immediately present themselves to the eye, consist of three kinds of surfaces—horn, naked skin, and feathers. The first of these requires little description, being only the bill, the claws, and partially the scaly coverings of the naked parts of the feet and toes, and is most conspicuous on the upper sides of the toes, and the anterior sides of the tarsi. The naked surfaces are also limited in extent, being confined to the head, portions of the neck in some genera, and those unfeathered parts of the feet and toes which are not covered by horny scales. The feathered parts are much more important in the popular description of birds, as it is to their forms and colours that the attention is first attracted.

The horny surface of birds varies in hardness in different species, and may, in general, be said to be firm in its texture in proportion as it is dark in colour. The more powerful birds of prey have the beak and claws black, with a slight bluish tinge; but some even of these have them yellow when in the immature state, whatever may be the colour when they are full grown. This change of colour in horny substances appears to be the effect of atmospheric air and light; and it is not confined to birds, but takes place in the hoofed mammalia, the young of which, in general, have the hoofs yellow, though they turn black after a short time. The forms of the bills and the claws of birds, being closely connected with some of their principal habits, will be noticed in another section of this article.

The naked skin of birds has generally a porous or spongy appearance; and in many species it has a bloom of colour in the living state, which is often very brilliant, and displays an iridescence which is not very easily describable, but which fades the instant that life is extinct. The bills of some birds, such for instance as the toucans, is covered with a membrane, in which there is a similar display of colour, that fades in the same manner; but in most birds these portions of naked membrane with perishable colours are on other parts of the body. When there is a naked membrane reflected on the upper mandible of the bill at its base, that membrane is called a *cere*, from its surface having some resemblance to that of wax. When it extends to, or surrounds the eye, it is called a *lore*, which means an armature, or covering. Sometimes there is only a naked spot or tubercle over the eye; in other cases there is a projection of naked skin on the top of the head, as in the domestic cock, which is called a *comb*, because it is often pectinated, or divided in its margin. Sometimes also there are pendent portions of naked skin hanging from the sides of the under-jaw, or from the cheeks, and these are called *wattles*. In some instances the anterior portion of the throat is entirely covered by tuberculated portions of naked skin; and that is often capable of inflation, as in the case of a male turkey. In other instances, again, the entire neck and greater part of the head are naked, and often beautifully coloured, as is the case in the king vulture. When a large portion of the throat or neck is naked, there is generally some portion of the neck or breast covered with hair, or at least with feathers very much resembling hair in their form; but what connexion there is between the nakedness of one part and this species of covering on an adjoining one has not been ascertained.

When the naked skin on the head, or partially on the neck, covers appendages rather than the natural form of the parts, it is found principally in the male birds; and in the pairing season, these appendages increase in size and heighten in colour, their general colour being red of some shade or other, often with blue reflections; but in many birds they are, at the season alluded to, of the most intense scarlet. The females of the gallinaceous birds, have generally some portions of naked skin on the sides of the head, which bloom and fade with the season, in the same manner as those of the males, though not with equal intensity.

No particular name is given to the naked skin on the feet of birds, unless it covers appendages, or extends farther up than the articulations of the tarsi, which are often styled the knees, but which are in reality the ankle joints of the birds. When there is a portion above these unfeathered, it is called the *garter.* It occurs chiefly in running and wading birds, and sometimes it is differently coloured from the rest of the feet. The appendages to the feet of birds consist of margins, lobes, and webs, which have all reference to water, or to soft and sludgy surfaces; and therefore the description of them falls properly within that of the general account of the feet of birds, as characteristic of their haunts and of one of their principal actions.

With the exceptions above stated, the bodies of birds are covered with feathers. These feathers are of three, or even of four kinds,—down or under-clothing, common clothing, or imbricated feathers, flying feathers, and supplemental or ornamental feathers, of which the uses, in the economy of those birds which possess them, are not very well known.

Before proceeding to consider the situation, structure, and use of the principal feathers upon birds, it may assist those who have not previously studied the subject, to examine the figure in the next column. Feathers vary so much with the habits of birds that it is impossible to select a specimen possessing all the varieties of characters; and therefore we have selected the common magpie, as one which is well marked in its general character, and also easily observed, from being of common occurrence and rather familiar in its habits. It is necessary, however, to notice, that the magpie is a peculiar bird, and that its form necessarily accords with this peculiarity, so that no general conclusion can be drawn from it; but we should have had nearly the same limited representation if we had selected any other specimen. The magpie is alternately a tree and a ground bird; and its structure adapts it for leaping up and down, and making its way among tangled branches, rather than for long flight. For this purpose, the wings are only of moderate length, but they are well adapted for taking the air at all angles, and also for turning. The tail too is much produced, capable of considerable action, and wedge-shaped; the first and second properties being requisite in the frequent ascents and descents of the bird, and the last in avoiding the twigs and other obstacles which the bird could not have so well avoided if the tail had been square at the end.

MAGPIE DISPLAYED, SHOWING THE MORE REMARKABLE PARTS OF A BIRD.—A, the ear coverts. B, the bastard wing. C, the lesser coverts. D, the middle coverts. E, the greater coverts. F, the primary quills. G, the scapulars. H, the secondary quills. I, the nape. K, the under tail coverts (not shown). L, The rump and upper tail coverts.

No particular name is given to the common clothing feathers on the head of a bird, but they are distinguished by the names of the parts on which they are situated—as the front or fore-head, the crown, and the occiput or nape, on the upper part; the cheeks on the sides; and the chin on the under part. There are often, however, supplemental feathers on the head, and these are distinguished as crests, conchæ, or beards, according to their situation. Crests consist of produced feathers on the upper part of the head, sometimes standing over the whole, or a greater or smaller portion of that, and nearly covering the eyes, as in some varieties of poultry; sometimes they are long and pendent from the nape, as in herons, divers, and generally in birds which strike forward with the bill with long and swift motion, in which the crest appears to answer nearly the same purpose as the feathers on a dart or arrow.

The conchæ are formed either round the eyes or the ears, but generally round the former. They are most conspicuous in nocturnal birds, especially in the owls; and they seem to answer some purpose in concentrating toward the eyes the faint light in which those birds habitually seek their food. The tendency to produce enlarged feathers on the sides of the head in some birds of this tribe is so great, that they rise on the sides of the head something in the same manner as the ears of cats; and the species which have feathers standing up in this manner are called "eared owls," or "horned owls;" but the names are not very accurately applied, or at least, they must be understood with some limitations, because the ears or horns are feathers merely, and have no projections answering to them either of the bones or of the flesh of the head. Feathers which form what are called beards, or mustachoes, are dependent from the angles of the gape, or the sides of the lower mandible, and proceed, for a greater or less distance, down the sides of the neck. They are generally of a different colour from the neighbouring parts, and remarkably soft and silky in their texture. Some birds have feathers similarly produced, and resembling these in their texture, upon the breast, the shoulders, or other parts of the neck, or adjoining it.

The only general groupes of separate feathers on the heads of birds, which get a distinct name, are those which are over the openings of the ears. They are called the *ear-coverts*, and the name "covert" is in general given to all those feathers, upon whatever part of the bird they are situated, which are not merely clothing feathers, and at the same time neither feathers for flight, nor supplemental or ornamental ones. Thus the word "covert" becomes a general one in describing the plumage of birds, and coverts are styled *upper* or *under*, according as they are on the upper or under sides of those members which they cover. Those of the ears are peculiar as covering, with more produced and downy plumage than that on the surrounding parts, the openings of these organs; and though their use is not very well known, they probably answer the purpose of external conchæ to the ears, and at the same time protect those delicate organs from the action of the air when the birds are in rapid flight.

The feathers on the neck and body of birds are also named from the places upon which they are situated. The neck is described as the throat, sides, and back. The distinctive parts of the body are more numerous; and they are often spoken of, generally, as the upper part and the under part. The entire upper part of a bird includes all that part of its surface which is seen when the head, the wings, and the tail are stretched out, and the eye of the observer placed opposite to the middle of the back. The under part, in like manner, means all that which is seen when the bird is stretched out in a similar manner, and the eye of the observer against the middle of the belly, or rather the posterior edge of the breast bone. But as these general significations of the terms include the wings and the tail, as well as the body of the bird, and as those organs require separate description, the upper and under parts are generally understood in a more limited sense, as not including these parts. Thus when it is said that the upper part, or the under part of a bird is of any particular colour, it is not meant to be asserted that the corresponding side, either of the wings or of the tail, is of that colour.

The upper parts to which names are given, are the setting of the neck, which is often marked by differently coloured feathers, or produced ones which form a mantle on the shoulders; the scapulars, or feathered parts over the blade bones, the middle of the back, and the rump or part of the back next the tail, which is often differently coloured from the rest. Upon all these, the feathers, excepting those birds which have supplemental ones, are smooth and close, and so beautifully imbricated, or placed over each other like tiles, that they form a very close and smooth surface, which is perfectly water-proof in some birds, and not very easily wetted in any.

The manner in which these and all the other clothing feathers are applied to each other, and also adapted to the shape of the bird, is well worthy of study. Generally speaking, they are placed alternately, or one over two, that is, with its shaft in the opening between them; but they cannot be said to form regular rows taken in any direction, and they vary considerably both in shape and in size.

They are all however placed in such a manner as that the action of the wind from before tends to smooth them down, and from behind to raise their points, though differently in different birds, and even on different parts of the same bird. The shoulders, and the turns or front edges of the wings, are the places on which the beautiful application of the feathers is most striking, as they are not only the most difficult to fit from their greater curvature, but the ones which are the most exposed during flight. The feathers on these parts are so placed, that let the wind take them as it may, it can hardly raise or ruffle them; and the strength and curvature of the shafts, and the extent and texture of the webs, are all equally worthy of observation.

The general texture of the surface of the upper feathers, is in most cases more glossy than that of the under ones; and in most birds it has more or less of metallic lustre, and generally, though not always, its colours are deeper.

The structure of the clothing feathers of birds might be almost made a means of classification, as it varies both with climate and with habit. These feathers upon birds of prey are firm and decided, so that each individual feather may be traced; they are less so in omnivorous birds, less so again in those which feed chiefly upon insects or vegetable matter, and the least so in birds which are the most exclusively aquatic in their habits. Birds of hot climates have also the feathers more decided in the upper part, than those of nearly similar habits which reside in cold countries:—indeed the study of the structure, texture, and gloss of the general plumage would, though somewhat more circuitously, lead as certainly to a knowledge of the characters of birds, as that of the more active parts of their bodies.

The feathers on the under parts are distinguished as those on the breast, the flanks, the centre of the belly, the thighs, and the vent. But some of these names must be understood with limitations. Thus what are usually called the thighs are in reality the legs of the bird, the thigh bones being to a considerable extent imbedded in the muscles, and capable of but little motion, except in those species which have great action in their feet. That which is called the belly of a bird also requires explanation; for it does not, even in any of the species, answer to the soft abdomen to which that name is given in the mammalia; and in swimming birds the sternum and ribs extend so far backward as that a portion at the vent only, of a size sufficient to allow the expulsion of the eggs, is unprotected by bones.

The feathers of the under part are, generally speaking, smaller in size, and softer and more downy in their texture than those on the upper part. The differences of character indicated by them are not so great or at all events not so striking as those indicated by the upper part. In general, however, there is the same gradations from the more perfect air birds to the more perfect swimmers, the last of which, especially those which inhabit the colder seas and do not migrate far toward the equator in winter, abound in down of the finest description. This down consists partly of a second feather produced at the end of the barrel or tubular part of the principal one, and partly of a separate clothing, each particle of which has its own insertion in the skin, and which has no distinct shafts, or any of the common characters of feathers. This down, whether produced on the feather or on the skin, is always frizzly or flocculent, as well as soft. It thus has no general direction, like the feathers, but stands every way; and thus is very elastic as well as warm and light.

The different apportionment of this downy part of their clothing to the several climates and elements in which birds move, as well as to their habits, is very remarkable; and many of the swimming birds can remain for days in water very little above freezing, and yet sustain no inconvenience from the action either of the cold or of the water.

The feathers of birds are in themselves, to a considerable extent, water-proof, and all birds are more or less furnished with glands near the base of the tail which secrete an oily liquid. This liquid the birds can reach and extract with their bill and apply it to the feathers, by drawing these between the mandibles. This operation forms part of the process of *preening* or trimming the feathers, in which birds occupy a portion of their time. They do this for three purposes—to strain the water from such feathers as get wet, to smooth the webs of such as get ruffled, and to apply the oily secretion as occasion may require; and they also make use of the bill in removing those decayed feathers which become incumbrances instead of being useful to the birds in their motions. The structure and economy of feathers, with the changes which they undergo from age, season, or climate, are, however, much too extensive for being explained in a general sketch; and therefore we must refer to the word Feather for the structure, and to the word Plumage for the economy and changes, confining the remainder of this section to the enumeration of the acting feathers and their auxiliaries in the wings and the tails of birds.

But as introductory to the notice of these, it may not be improper to remark that, generally speaking, the nearer that the clothing feathers of birds approximate to the form of flying feathers, the latter are the more firm and perfect in their structure; and that this holds not only in different species of birds, but in the plumage of the same species during its progress to maturity. There is even a gradation from the ordinary clothing feathers to the flying ones through the medium of the coverts.

In the wings, the bones, the humerus, the fore-arm, the wrist, and the hand, are free. They, and the muscles on them, are clothed to some extent with feathers similar to those on the body, and partaking of the character of upper feathers above the turn, and under feathers below it, passing imperceptibly into each other on the turn itself. To these succeed the several coverts, of which there are generally three rows, more or less distinct, and more or less produced, according to the species, but generally increasing in length and strength as they approach the quills. These are called the lesser, the middle, and the greater coverts, of the particular quills, or portion of the wing to which they are applied; and there are similar coverts on the under sides of the wings, only these are weaker, smaller and more soft and downy in their texture,—the whole under side of the wing being so formed as to take the greatest possible hold on the air, while the upper side is formed for rising through the air with the least possible resistance.

The quills, or real feathers of flight in the wings, are distinguished as primaries, secondaries, and tertiaries, according to the place of the wing to which they are attached. The primaries are attached to the hand and wrist, forming the extremity of the wing; and they are, generally speaking, the longest and the most powerfully supported by coverts. The secondaries, which are shorter, are chiefly inserted on the bones of the fore-arm; and the tertiaries on the humerus. In some birds the tertiaries are the shortest quills in the wings; but in others, and these are generally birds which have the habit of running swiftly, with the wings partially extended, they are so much longer than the secondaries that the bird has the appearance of double wings, one set near the body and a longer set farther off. The quills are usually distinguished by numbers, as the first, second, and so on, counted from the extremity of the wing.

The tails of birds, like the wings, consist of produced feathers and coverts for their support, though the feathers of flight in the tails do not get the name of quills.

Both the wings and the tails of birds vary much in form, in magnitude, and in power of action; and though they are both concerned in the flight of the bird, and partially also in its motions on land or on the water, they do not vary according to the same law, and therefore they do not indicate the same habit. Still, however, as they are both concerned in the flight, or other motion of the bird, they must, in all their apparent discrepancies, be the best adapted to each other.

In those land birds which have not the power of flight, such as the ostrich, the emu, the apteryx, and a few others, none of the feathers have much approximation to the character of flying feathers, properly so called: they more resemble a peculiar species of down, but still it is feathered down, and the different portions are more minutely feathered in their ramifications than even those of flying birds; so that all the produced feathers upon these species are calculated for taking a powerful hold on the air; and the hold so taken no doubt helps to support the birds as they walk along. This use of these produced feathers is rendered more probable by their being more conspicuous in proportion as the bird is longer on the legs and otherwise better fitted for swift motion. The emu is not so swift footed as the ostrich, and the feathers upon it are all more nearly of the same length and form. Judging from its structure, for of its habits we know nothing, the apteryx is but a slow moving bird, and the feathers upon it are all pendent and flexible, resembling thatch as much as they do ordinary feathers.

The supplemental or ornamental feathers, of which the uses are not well known, appear on various parts of the body. They are generally confined to the male birds, or at least most conspicuous in them; and in some instances, as in that of the ruff, they make their appearance only during the breeding season. Birds which are subject to additional plumage, or even to rich additional colours in their feathers, during the breeding season, are generally, if not invariably, birds of warm temperament, and excited to contests of gallantry with each other, and other displays of more than ordinary courage, at that season. The affection appears to be one of the whole body, though the effects which it produces are differently localised in different species. Sometimes the additional feathers are on the neck, sometimes in the crest, sometimes in the scapulars and feathers of the back, and very generally in the tail.

The use of these feathers in the economy of the birds is not known; unless it be that the production of them (for feathers appear to be one of the most elaborate of nature's productions), exhausts the surplus of that energy which, from its very violence, might otherwise be injurious to them at those times when they do not require to exert it immediately for those purposes which, physiologically considered, it is intended to answer.

This is an exceedingly curious part of nature; but it is as obscure as it is curious. In all the living and growing races, there is a bloom or evolution of richer and more intense colour than that which accompanies ordinary growth, attendant upon the process of production. This is less conspicuous in the animal kingdom than in the vegetable; and in both, those species in which the process is otherwise secret or obscure, partake little or nothing in this rich display; but it is to the nuptial dresses of plants and of birds that the gay season of the year owes the most of its beauty; and nature, true to her general law, lavishes the richest of her ornaments upon the most essential of her operations—upon that operation by which alone she maintains all the races of her children, and triumphs over time itself.

As the uses of those supplemental feathers, whether seasonal or permanent, are not known, they cannot be used for any purpose more general than that of being specific or trivial characters of the races in which they appear. We must therefore refer the further consideration of them to the particular articles descriptive of these.

III. Skeleton of Birds.

As it is not the province of natural history, especially of that popular form of it to which this work is restricted, to enter into the details of anatomy, any farther than is necessary to obtain a general notion of the way in which the motions of animals are performed, the present section will be very short. We have already alluded to some of those peculiarities in the bones of birds, which enable them to perform their chief aërial motions; and our main object in again reverting to this part of the subject is to place before the reader a sketch of the bones of what may be considered as the model or utmost perfection of a bird, before proceeding to point out how the classification of birds is founded upon one or more of their three grand actions, as these are dependent upon, or arise out of their varied organisations.

This sketch represents the bones of the Jer Falcon (*Falco Icelandicus; Hierofalco*, of Cuvier), which is the boldest, the most perfectly winged, and, in proportion to its weight, the strongest both for action and endurance of all the feathered tribes. Dwelling in the wilds of nature, subjected to violent winds, to heavy snows, and to long-continued rains, and compelled often to endure long periods of abstinence in those parts of the world where there is not a tree, and hardly even a bush, for the shelter of a bird, and requiring at other times to range for several hundred miles before it can procure a meal, either for itself or for its young; the jer falcon, estimating according to the average powers and experiences of animals, may be said to have the hardest lot in the whole kingdom. But even upon this, the grand extreme, as it were, of his works, the Creator has not left himself without a witness; for if the task which the jer falcon is called upon to perform in nature is harder than that of most other birds, the preparation of this falcon for the performance of it is greater in fully the same proportion.

Jer Falcon.

The sketch which we have given of this bird, which is, now at least that falconry is not the fashion, rather rare in substance, in skin, or in skeleton, is taken from a very fine specimen in the possession of Mr. Yarrell, which that gentleman very obligingly lent us for the purpose. It was originally obtained from Iceland; and we believe in part at least cleaned and prepared by marine insects on the Iceland shores; and these creatures are far from the worst preparers of the skeletons of larger animals, when the object is to have them perfectly clean and at the same time quite entire.

It is impossible to do justice to so complete a piece of natural mechanism in a sketch, and it would be no easy task even for the most elaborate engraving; but the general arrangement of the bones, and their remarkable compactness and adaptation to the powerful actions of the wings, the feet and the bill, can be easily seen. Of these motions and their organs, as diversified in different tribes, we shall have occasion to speak afterwards; but we may here notice that the jer falcon possesses all the three in the highest perfection; and that as, although it is a day preyer, it must often prey in lowering and cloudy weather, its power of vision must be strong in proportion. It must also, adapted as its plumage is to the violence of storms, have some very acute means of general perception, otherwise it could not return to the islands which it inhabits, after its long excursions over the northern ocean.

The most remarkable general property of this skeleton is its compactness, and the equal perfection with which, as an artist would say, all its points are made out. None of the bones are very long ; and those of the legs, as the bird is not much in the habit of walking, are rather short; but they are firm and well proportioned, and the processes toward their extremities, whether for giving firmness to the joint, insertion to the muscles, or lever power to the tendons, are very conspicuous.

The general form of the spine, as it has already been hinted at, can be seen in this example. The vertebræ of the neck all admit of ready motion ; and the position of repose, or that in which all the bones bear equally upon each other, is a curve.

All the vertebræ of the back, at least as far as the posterior edge of the sternum on the other side, are soldered together, and afford a firm base for the blade bones, which are considerably produced, and lie nearly parallel to the mesial line of the spine. The coracoid bones are strong, and enlarged at their extremities where they meet the anterior edge of the sternum, though they are more flattened there, so as to agree in thickness with that bone. The furcal bone is also a perfect circle, and placed with its flat side in the direction of the strain, so that it resists the separating or bringing together of the shoulder joints, the grand centres of motion for the wings, in the most powerful manner that could be obtained from the same quantity of bone. This bone, it will be perceived too, forms a large opening, in which the neck can play freely, without the least pressure upon any of the important vessels which it contains.

All the bones of the wings are well formed, and the fingers, though only one of them is perfect, can be distinctly traced. The humerus is the longest and also the strongest and heaviest bone in the wing ; and the lengths of the others diminish in the proportion of their other dimensions ; so that though when the wing is moved, the different parts move with velocities proportional to their distances from the centre of action, yet the effect of the entire wing is very uniform, and the bird, when in powerful action, may be said to fly with the whole of it, that is, to strike the air with nearly equal effect with the whole of its under surface. The stiffness of the intermediate joints in such a wing, the perfect freedom of the shoulder joints, and the remarkably steady base which from their size, form, and place, the scapular, the coracoid, and the furcal bone, give to the centre of action, render the flight of the bird exceedingly smooth ; and, though it is heavy for its bulk and even for the length of its wings, the jer falcon never appears in the least to labour on the wing. Birds more loosely boned, in any of the respects that have been mentioned are incapable of this perfect steadiness and beauty of flight. The short winged ones of them flutter, as if they had not wing enough, and the long winged ones have their bodies tossed upward by the down stroke of the wings, and downward by the up stroke, as if their wings were too much for their management. This falcon, however, which has to range over somewhat bare and very stormy pastures, has its wings and its body adapted to each other with the utmost perfection, so that it can rush onward in any line of direction that it pleases, without the least deviation ; therefore it flies from point to point by the shortest line possible ; and thus while it is the perfect model of power in flight, it is at the same time the perfect model of economy.

The lumbar portion of the jer falcon's spine admits of a little bending downwards, so that the articulations of the femoral bones, or those joints which answer to the hip joints in the mammalia, can be lowered a little. The bones of the tail are also more numerous and better " made out" than in most birds. This arrangement of the posterior portion of the sternum, enables the falcon to perform more effectively its double action in the air, as by this bending, the foot, with which it strikes its prey, can act so far below the plane of the wings as not to interfere with their motion of flight. Not only this, but it also affords a support to the tarsus, upon the joint of which the whole force of the stroke would otherwise be thrown as a cross-strain ; and, though that joint is a firm one, yet it is contrary to the general law of nature's mechanics, to subject even the firmest joint to the greatest strain which it has to bear in the least favourable position. Indeed, there is seldom any joint subjected alone to a very great strain, in the natural action of animals. As there is but one life in the animal structure, so there is always concerted action when that life is strongly excited, be the object of the excitement or the organisation which it more immediately sets at work, what they may. There is some part upon which, in case of partial failure, the acting part can fall back for support if not for assistance ; and the very fact that organs which have to perform violent motion, are connected with several centres, and those centres all susceptible of yielding to some extent or other, shows that the animal is organised for a concert of the parts in its action.

There is much firmness in the foot and leg of the falcon, and the position in which the foot is carried when hawking, stiffens the hind toe by pulling the tendon, and that without any muscular exertion, to the very angle at which the claw gives the stroke with the greatest effect. It is an oblique thrust, neither directly against the end of the last phalanx of the bone, nor across it, but in a tangent to the curvature of the claw at its point; and any one upon examining the foot of a falcon, will find that this is the very direction in which a shock can come so as to jar or strain the least possible, and at the same time to divide the pressure most equally among all the joints of the member which acts. If the stroke were given directly in the line of the axis of the toe and claw, the crush or jar would be the greatest possible ; and any one who unwittingly strikes the point of the stiffly extended finger against an obstacle can tell how much more painful it is than if the yielding finger struck the same obstacle with double the force. There is another very appropriate illustration : by holding the joints of the legs and feet easy, one can drop upon the feet from a considerable height, not only without risk, but with little pain or shock at the moment ; whereas if one were to drop even two or three feet with all the joints of the legs and feet kept purposely extended and rigid, the pain from the jarring would be considerable, and a tumble would be the probable, and broken bones or dislocated joints, the possible, and indeed the very likely consequences. Thus we see that in nature's mechanics, the contrivances by which purposes are accomplished, are not only the best adapted for those purposes, but they are applied for the accomplishment of them in the best manner, both for success in the end and for safety to the instrument.

This principle is one of the most difficult to carry into complete, or even tolerable effect, in the whole compass of human mechanics; but it is one which nature invariably displays in all her structures, and in all the varieties of their working. This must, however, in the case of animals, and especially in that of predatory animals, be considered true only as affects the animal to which the structure belongs: for as the prey and the preyer are part of the general system of nature, and as such made for each other, the perfection of the system requires that the prey should be taken as much at a disadvantage to itself as there is advantage on the part of the preyer.

And this is well exemplified in all birds which strike, or otherwise capture their prey on the wing, and more especially in the jer-falcon, which may be said to perform that operation in most magnificent style, at least in so far as the slaughter of one bird by another can be considered magnificent. The jer-falcon, at forward flight, and without the excitement produced by the joint effects of hunger and the sight of that which can appease it, can cleave the air at the rate of at least one hundred miles in the hour; but when she works herself to the top of her bent, and then rushes forward in the tempest of her impetuosity, her motion is double, triple, nay, probably more than five, or even ten times that rate; so that if she could hold on with the same speed, she would keep pace with the motion of the earth on its axis, even at the equator, where it is about a thousand miles an hour, and outstrip it by much in her own northern latitudes.

Hard as are the bones, and tough as are the tendons and ligaments in the foot of the jer-falcon, they could not hold directly against so terrible a rush as this; and were she to strike against a solid and fixed substance, she would be dashed to pieces by her own velocity—would perish through the very excess of her own strength.

But this violent motion of the falcon, the circumstances under which it is exerted, and the organisation by means of which it is performed, are all admirably adapted to each other. The stroke of the falcon, unlike the spring of the beasts of prey, or even the stoop of the eagle, and the other predatory birds which kill their prey upon the ground, does not, in itself, arrest the violence of her motion; for when she misses, if she hawks at flocking birds, as she often does, she dashes onwards, and strikes again; whereas the lion and the tiger must pause and crouch before they can take a second spring, and the eagle must regain her height before she make a second stoop. Thus the prey of these animals, if not captured at the first attempt, has a chance of escape much greater than the prey of the jer-falcon.

When we consider the circumstances under which this gallant bird strikes, and the force of the stroke, which is sufficient to fracture a wing, sever a head, or crush the chest and burst open the body of a bird, we can easily see that the great velocity of the rush is necessary for effecting the natural purpose of the bird; and that, though the jer-falcon would probably dash herself to pieces where she to exert all her energy in preying anywhere else than in the free air, yet she is exactly the bird, above all others, for that element. Her prey is of course escaping from her with its best wing, though the agitation produced by such a follower must of course render that wing a little tremulous; but still the motion of the prey must be deducted from that of the falcon, in order to get the true impetus with which the latter strikes. Besides this, the bird has no resistance but that of the all-elastic atmosphere, and the inertia arising from its weight diminished by its motion; and therefore a stroke given with moderate velocity would have very little effect upon it. But the speed of the falcon over the speed of the prey furnishes the power; and the instrument, as already mentioned, sustains no injury on account of its position, and of the communication, and consequent extinction of the shock upon it; first, in the elastic part of the falcon upon which it bears for support; and, secondly, in the air, against which the entire body of the falcon would recoil if necessary, as the smaller hawks may be seen to do when they are flown at too heavy game.

Far from the least remarkable part of the skeleton of this model of a flyer is the sternum. It will be observed, on looking back to the sketch, that the forks in the posterior portions of that bone are not only united by bony continuations, but that only a small aperture is left in the place of each. The keel, or central ridge of the sternum, is also remarkably elevated, and much produced at its anterior extremity, so that its outline forms a complete arch. We shall afterwards have to compare the *sterna* of different genera with each other, and with their several habits, as among the means of forming an arrangement of the class, approaching at least to a natural one. But as in that we must have some model from which to start (the means of proceeding then being comparison, and comparison not being an instrument of knowledge, unless one of the subjects is known), and as the sternum of the jer falcon is the one best adapted both for exceedingly rapid and for long-continued flight, it is about the best model that we can select. From the shape of this bone, as well as from the general arrangement of the skeleton, we can see that, though the legs are rather strong in their bones, and the muscles by which they are moved are rather powerful, yet that the great strength of the bird is thrown into the anterior part of the body. Here it is not a little remarkable that this form of the body of a bird, while it admits of the best organisation for flight, is also the best one for being propelled through the air, or through any other fluid, be the propelling force what it may. When it is desirable to have a very fast-sailing ship, which shall at the same time make the closest course, or the least lee-way, and therefore get through the water with the least strain from the action of the wind, the shape which answers best for the hull of such a ship is not unlike that of the jer-falcon—full at the bows, and narrowed away at the stern, so as to make the least wake or turbulence in the water behind her. This coincidence of the shape of birds which impel themselves through the air by the energy of their own muscles, with that of ships which are impelled through the water by the action of the wind on their sails, is not a little remarkable; and it is one of those cases which shows that there is a lesson for our instruction, and an example for our imitation, so far as we can imitate, in all the operations of nature.

Before taking leave of this branch of the subject we may further remark, that there are three muscles on each side of the keel of the sternum, in all flying birds; and that the principal action of the wing in flight is produced by those muscles. There is an advantage in this arrangement; and so also is there an advantage in that arrangement in the legs of birds, by which the muscles of these are placed near the body, and the tarsi and part of the tibiæ formed chiefly of bones, tendons, and ligaments. By the arrangement in the wings, the wing itself is rendered lighter than if muscles had been distributed over its whole length, to any greater extent than is necessary for stretching and bending the local joints. Not only this, but the circulation of blood necessary for the support of much muscular energy, and the supply of the waste which that would occasion, could not be carried on without an extraordinary propelling power, in organs which move so rapidly as the extremities of the wings. Here, again, we may perceive a remarkable coincidence of advantages. That structure of the wing which adapts it best for being an organ of support and progressive motion jointly in the air, is also the one which renders it the most easily moveable and the most easily nourished, so that the labour, whether mechanical in the muscles, or physiological in the energy of life by which the muscles are worked, is always the least possible in proportion to the motion produced; and thus while every bird has enough and to spare of energy for the average performance of those functions required for its place in nature, it is at the same time an instance of the most perfect economy in the whole of its furnishings and arrangements.

Of the three muscles on each side of the sternum, by far the largest one is that which depresses the wing. It is called the great pectoral muscle; and, in birds of powerful flight, those two muscles are heavier, or contain more substance than all the other muscles in the body. The second muscles raise the wings, and prevent them from turning on edge, which neither of the other muscles could do without impeding the freedom of their proper motion in working the wing upwards and downwards at right angles to the axis of the body. There is, however, a slight oblique motion in the elbow joint of the wing, by means of which this third or central muscle causes it to strike partially forwards, at the same time that the great pectoral muscle makes it strike downwards.

Such are some of the motions of the more efficient wings of birds, and such some of the instruments by which they are performed; but from the jer falcon, in which they are the most perfectly developed and the most in accordance with the whole skeleton and other structure,—and therefore form, along with the most predatory claws and beak, and the digestive organs the best adapted for subsistence upon recent flesh, the most direct means of arriving at the habit and character—there is a gradual decline of the efficiency of the wings, as compared with the other active structures, until we come to the ostrich, which has only a sort of rudimental flaps to steady it as it runs, the penguin, whose rudimental wings seem to answer only the same purpose in swimming, or the apteryx, whose wings are covered by the skin, thatched by the feathers, and seem to answer no purpose whatever. But though there is this gradation, and though in as far as the wings, and all those parts of the skeleton, and the muscles which are connected with the wings, are concerned, we can trace it with comparatively little difficulty, yet it is so far from taking the habit of the bird along with it in any other respect than that of mere flight, that one pair of wings carry us to the sea, a similar pair to the forest or the plain, and a pair still similar to the cliff of the mountain. Nor are the purposes for which the wings carry the birds, and also us in the study of them, less varied than the places,—wings very similar to each other, act to capture warm-blooded animals, insects, fishes, berries, seeds, and so endless a variety of substances, that we are compelled to examine the other characters of the bird before we can arrive at any certain conclusion respecting the office which it performs in nature, or the use to which it may be applied in art. We are not, however, to attempt making a classification of birds, but to explain the principles of one which is already made; and therefore the shortest as well as the simplest course would be, first, to mention the classification, and then to point out those peculiarities in the three grand actions of birds, and their requisite organisations, upon which that classification is founded.

IV. Classification of birds.—In this we shall, as already said, adopt chiefly the arrangement of Cuvier, not that it is perfect, or even free from objection in all its parts, but because the well-earned celebrity of its author has given it a stability in the general opinion of mankind, the overturning of which would require much knowledge and more hardihood; and be, till more knowledge is obtained, after all a work of supererogation, except in some of the details.

Cuvier divides the whole class into five orders,—Birds of prey (Accipitres); sparrow-like, or hopping birds (Passeres); climbing birds (Scansores); poultry birds (Gallinidæ); running and wading birds (Grallidæ); and web-footed birds (Palmipedes). This certainly has the advantage of that simplicity of which it partakes in common with other *artificial* systems of the works of nature, that the first step in the knowledge of it is very easily taken. But it has, at the same time, all the counterbalancing disadvantages. It does not simplify the knowledge of birds; it is only simple because it conveys very little knowledge. When we come to grapple with the real knowledge, we must go to more minute divisions, and encounter much more labour; but even thus much is a beginning, and may prove an incentive to some, though it may also lead others to be content with the shadow without the substance, as has been remarkably the case with the Linnæan artificial system of Botany.

The characters of these orders, as well as of the tribes or families into which they are divided, and the genera and species of which they are made up, will be found under their respective names in the order of the alphabet, and therefore we need not here enter into the particulars. But, as we cannot show the connexion which there is between the three great systems, to which the bills, the wings, and the feet, are, as it were, the keys, without some notice of the general characters on which the orders are founded, or at least their fitness for being such a foundation, we must devote a few words to each.

Accipitres. This order is the most natural in the system, and it is so, because it is founded not upon a single character, but upon the general habit of the birds, in the formation of which all their leading organisations bear a part. The distinctions of the two primary subdivisions of diurnal, and nocturnal or crepuscular feeders, are distinct, so that the one cannot, in any species, be mistaken for the other; and though, especially in the diurnal division, there is a very considerable gradation in all the leading characters, so that those at the one extremity differ much from those at the other, yet there is enough of general resemblance preserved, in the beak, the feet, the wings, and even the plumage, to distinguish them from the birds of every other order.

Passeres. This is a much more numerous order than the birds of prey, and by no means so natural. This might be expected from its extent, and also from the name, which being that of one genus, or species of bird, that of the sparrow, can have little meaning as descriptive of an order.

The five sub-orders or tribes, into which it is divided, improve it a little, but still they are far from perfect, as they bring together in the system birds whose structures and habits are very different from each other. These five orders are, *Dentirostres* (toothed bills), which are, generally speaking, feeders upon insects or mollusca, though some of them occasionally kill birds; *Fissirostres* (open bills), in which the mandibles do not shut close for their whole length, which are chiefly insect-feeders, and catch their prey by hawking on the wing; *Conirostres* (conical bills), which have the bill more or less enlarged at the base, and tapering to the point, which are more miscellaneous in their feeding, but differing so much in their characters and habits, that no one can be selected properly descriptive of the whole tribe; *Tenuirostres* (slender bills), which feed much on larvæ, and other small animals in the soft state, but catch them in such different situations and ways, that they can hardly be said to have one very striking character in common; and *Syndactyles* (united toes), which agree in that structure of the feet, and in several characters, though they differ in others.

That the last of these tribes or subdivisions of the order is founded upon the structure of the feet, and all the others upon that of the bills, is of itself sufficient to show that they cannot be very accurately descriptive of the birds. *Dentirostres* is far from accurate, because the birds have a notch in the bill rather than a tooth. The falcons are the true dentirostres, the tooth in the bill being one of their leading characters, and they are the most typical birds in the order accipitres. Besides, these birds are not the only ones which have a notch in the bill, for some of the divers, and other fishing birds, that have not the tomia of the bill serrated, for the prehension of their slippery prey, have it notched towards the tip. This subdivision of the order contains birds so different, both in appearance and in habit, that it does not admit of much useful general description; because the characters applicable to one part of it could not be applied to other parts without so much modification as would render them almost entirely new.

The *Fissirostres*, or open bills, are much better. They are but few, and though some of them are nocturnal, and others diurnal, yet they agree tolerably well in their general habits. Their bills are all very broad at the base; they are very wide in the gape; and they do not close in the length of the tomia, so as to cut or bruise hard substances. The whole division are consequently insect-feeders, and feeders on the wing, as this form of bill is not adapted for picking food out of crevices, or even off the ground.

The *Conirostres*, though not quite so vague as Dentirostres, are still by no means well or generally described by the name, as any one will perceive upon finding that it includes the lark, the raven, and the bird of paradise, three genera which are unlike each other in appearance, character, haunt, and manners. The name is not indeed accurately descriptive of the bill, as it appears generally in birds of the division. No doubt the bill is, generally speaking, enlarged at the base, and tapering toward the tip, straight, or free from any notch in the tomia, more firm in its general texture, and especially in its cutting edges, than the notched bills of the first division; but it is conical only in a few genera, and most conspicuously so in the grosbeaks and finches. In other genera it is of a great variety of shapes, sometimes angular, sometimes arched in the culmen, sometimes coulter-shaped, and, in fact, of so many different forms, that it cannot with propriety be described by any one general epithet, for the more accurately which that epithet were descriptive of the bill of one genus, it would be the less descriptive of that of others.

There is, however, a shadowy sort of general resemblance in texture and function among those bills, though it is not very easy to find an appropriate name for it. The texture, at least at the cutting edges, is always firm; these, in general, close for the whole of their length, and thus they are capable of bruising hard substances, such as seeds with tough coats, and also for digging or boring into the ground in quest of earth insects, or of albuminous roots. Sometimes, as in the case of the crossbills, the bills of those birds have a very peculiar structure and action; and, generally speaking, the muscles which move the bill are more powerful, and consequently the head is more enlarged than in the species which feed more exclusively upon insects.

The birds of this division certainly range awkwardly together, whatever name they may be called by; and yet it is not very easy to separate them into groups more numerous than families or genera, in a manner that would be much less exceptionable.

The species which may be considered as forming the one extreme of the division are birds of powerful form and firm plumage. Many of them are voracious, and somewhat gross in their feeding. They eat all manner of carrion and garbage, have no great objection to kill any animal which they can master, especially if they find it in a sick or weakly condition. Some of them occasionally hawk after small birds on the wing, but that is not a general habit with them; they proceed by stealthiness and craft rather than by daring, as the accipitres do, and in general attack only that which they can take at a disadvantage. They are also great plunderers of the nests of other birds.

The species which may be regarded as forming the opposite extreme of the division are birds of very different characters and habits. They are of small size, not much disposed to attack other birds for the purpose of preying upon them, and, generally speaking, vegetable feeders, though most of them add worms and the larvæ of insects at the time when they have their young.

These two have been named from the general nature of their feeding—the first, *Omnivora*, or general feeders; and the second, *Granivora*, or feeders upon grains, or vegetable seeds. These names are not, in themselves, very precise, as Omnivora is rather too general a name, and other birds are scarcely less omnivorous than them, as, for instance, poultry are very miscellaneous feeders. Granivora is quite as vague, as pigeons, and some other birds, feed as much on the seeds of vegetables as the birds of this division.

Still, as applied to the extremes of the division, these names, with some explanation, would not be undescriptive. But it would not be easy to make a perfect separation of the two, for their characters pass so gradually into each other, that there are many genera of which it would be no easy matter to decide whether they are more omnivorous or more granivorous; and thus their place in the one group or the other would be much more a matter of fancy than a matter of science.

This blending of characters on the confines of the different divisions, in what manner soever those divisions are made, is, in addition to the confusion produced by the three principal means of classification, one of the great difficulties in the proper arrangement of birds. If the comparison may be allowed, birds are like the tints of the rainbow; we can call these red in one part, yellow in a second, green in a third, and so on; but no art can fix a line any where in the bow which can so divide colour from colour, as to enable one to say, "all on this side is yellow, and all on the other side is red." Even the colour which we can name the most readily is of no measurable breadth as one uniform tint; for the moment that we, for instance, lose the red on the one side of the yellow we begin to find the green on the other; and therefore, however small a portion of the breadth we take, we always find that, as compared with the whole, it displays more than one tint.

It is very much the same with birds; and birds, like rainbows, are children of the sun, more affected by that luminary than any other vertebrated animals, and partaking more of those radiant hues which the pencil of the sun alone can limn. We never can draw a definite line between order and order, or group and group; and as little can we find even a single genus which has no conformation or habit in common with another. When we put the rest of the rainbow out of consideration, we can give a name to the tint of any particular part; and, in like manner, when we take a single species of bird, and examine it without reference to the rest of the class, we can describe all its appearances and habits, so far as they are known to us, in a manner perfectly satisfactory. We can thus study birds, and know them, and learn from them, with perfect ease and certainty; but we cannot classify them.

The great locomotive powers of birds are among the chief causes of this. What with their ordinary journeys, and what with their seasonal migratory ones, they are here, there, and everywhere. Sea or land, mountain or plain, waste or cultivated field, we find them there as inhabitants or as passengers; and there is not a spot of land or spot of water but may become the inn of a wayfaring bird. Their clothing adapts them well to the weather; and it is necessary that they should not be very particular in their food, for they are exposed to many changes of it, and must frequently take what they can find without any choice. It is for this reason that classifications founded on the shape of the bill fail so much in other respects; and this is peculiarly the case with the dentirostres and conirostres of Cuvier's order *Passeres*, whose bills are very differently formed in the different genera.

The *Tenuirostres*, or slender-bills, form a much more natural division, though they too vary considerably in the different genera, both in the kind of their food and in the places and manner of finding it. Their bills in general accord with the name in being slender; but the smallness of their diameter is no indication of weakness. On the other hand, they are very firm in their texture; and though, from their form, they are not so well adapted for breaking hard substances between the mandibles as the larger hard bills of the former division, they can reach their food in places which are not accessible to these. Many of them are bark birds, which run in all directions upon the boles and larger branches of trees, and extract the insects or larvæ which are lodged in the crevices. Some of them run upon walls and rocks, and catch spiders in the same manner; while some again hover over the nectaries of flowers, from which they extract honey or small insects. They are an interesting race, from the agility of their motions, often for the brilliancy of their colours, frequently for their great power of wing as compared with their size, and not unfrequently for their extreme littleness. The humming-birds, which make the air under the action of the equatorial sun so gay with gleamy tints as if all the gems and the finest metals were flying about, belong to this division; and some of them, while to appearance not bigger than humble-bees, have the sternum and all the apparatus of flight nearly as well developed and as perfect as in the jer falcon.

But though this division is a very natural one, it is doubtful whether the bill is the best foundation for their natural distinction from other birds, as it is neither their most constant nor their most conspicuous character. The bill is always slender at the tip, and it cannot be said in any instance to be thick in proportion to its length, but it is often a large bill for the size of the bird, and it varies considerably in shape. Thus in the nuthatch the bill is straight, very strong for its thickness, being fortified with angular ridges on the culmen and at the edges of the mandibles; and thus it is capable of digging into the bark of trees, or hewing open the shells of nuts. It is partially a vegetable and partially an insect feeder. The rest of the family or division have the bill of weaker structure, generally larger, more slender, and not so straight; and some of the humming-birds have the tip of it so formed as to answer as a sucker. Thus, though the bills of all may without impropriety be said to be slender, yet slenderness is not a character of them, neither have they any one remarkable character which is common to the whole.

The feet form a better, or, at all events, a more constant character. These are all of the kind of double climbing or perching feet, of which some account will be found in the article Anisodactyli; and the using of these as characteristic of the division, rather than the mere slenderness of the bill, which, as has been said, is not a very constant character, is attended with some other advantages. It leads more naturally not only to the following and last division of this order, but to the order which Cuvier has placed next in succession, and which, if we take the general habits of the birds in both, has really more of what is called natural affinity to this division than it has to the one which Cuvier interpolates between them.

The *Syndactyli* form the only division of the order *Passeres*, which Cuvier classes from the structure of the toes; but if the leading character is, as it unquestionably ought to be, taken from the most efficient part of the organisation, then this is the very last class of birds which should have been characterised by the feet. All the division are energetic and active birds; but their feet are not only the least efficient parts of their own organisation, but they are among the least efficient for any active purpose, that are to be found in the whole class. There are birds which are worse walkers, though these are but lame at that kind of motion, and not much in the habit of using it; but then in most, if not all, other birds, which have the feet badly adapted for walking, they are on that account better adapted for some other purpose. They are climbing or swimming feet in proportion as they are ill adapted for walking; and even in the case of the swifts, (though the common swift has got the name of apes, or "footless,") the foot, short and weak as it is, is well adapted for taking hold on an upright wall, or the face of a rock; and the toes and claws have the form which is the very best adapted for these purposes. But though the feet of the birds of this division are, of course, as well adapted to the purposes which they are intended to answer, as the feet of any other birds, yet those purposes are not very important, nor very constantly required in the general economy of the birds. Such of those birds as nestle in holes in the earth, which is a habit with many of them, use their feet adroitly in the digging of those holes; and they can also perch upon bushes or trees; but they generally feed upon the wing, and never use the feet for any purposes, save those of digging and repose. Some notice of the structure of these feet will be found in the article Bee-eater.

The birds of this division have some resemblance to each other besides the mere shape of the feet; although none of the names by which they have, either in whole or in part, been called as a group, is very applicable. Those which have been styled *alcyonidæ*, after the kingfisher, have neither the form nor the habits of that genus, as it lives in great part upon small fishes, while those other genera which are classed with it live much upon insects. The hornbills, or rhinoceros birds, which, along with the same description of feet, have many of the habits of omnivorous birds, could not be brought within any group, the character of which were to be taken from the bill. Indeed the bringing together of the birds which are included in this division, appears to be rather in order to prevent them standing alone, than because of any well marked general affinity between them.

Cuvier's third order Scansores, or climbers, though named from the habit, is in reality, like the last division of the second order, founded upon the structure of the feet, and therefore the name of Zygodactyli, or "yoke-toes," which has also been given to them, is fully the more accurate of the two. A style of motion, or any other habit, taken singly, is rather a loose ground of classification. It is so with climbing in the case of birds of this order. It is not climbing generally, but climbing in a particular way, which is descriptive of them; and then that does not apply to them all. They are not the only climbers among birds; for the nut hatches, and especially the creepers, which are, in the same system, classed with the slender-bills, and others of the anisodactylic birds, are much more adroit and graceful climbers than these. Birds of this order are all, almost without exception, tree or forest birds: the greater number of them are inhabitants of the rich forests of tropical countries; and these are generally gay in their plumage. Indeed, the woodpecker and wryneck of our own country are showy birds; and perhaps the one of most sober plumage, though peculiar from its habits, and interesting from the time of the year at which its note is heard, is the common cuckoo.

The feet of these birds are grasping rather than climbing feet. The exterior front toe is reversed, so that the toes act two against two, which is the reason why the birds are called zygodactylic, or yoke-toed. In some of the species the feet are used in the same manner as the grasping feet or hands of the tree mammalia; and as some of these climbing mammalia use the prehensile tail as a fifth hand, some of the climbing birds use the bill or beak as a third one. Those which have that habit, have the upper mandible hooked at the tip; and the acting parts of both mandibles are short, but very strong, and act with much force like nutcrackers. The muscles which move these powerful mandibles, give considerable enlargement to the sides of the head. Those which have this habit are mostly vegetable feeders, and live among the twigs, nestling in the holes of old trees.

Taking the whole together, they are not a very natural order, even in the use of that part of their organisation after which they are named;—for whether, with Cuvier, we call them "climbers," after the habit, which is not general, or with others "yoke-toed," after the structure, which is general, though much modified in the different genera, their feeding, the structure of their bills, and many of their modes of life differ greatly from each other.

In their feeding several of the genera of this order bear a considerable resemblance to the Gallinidæ, or poultry birds, at least to those species of them which are natives of the forests of warm countries; and there are two genera, if not more, natives of Africa, which appear, as it is usually expressed, to "connect" the two, that is, which partake of the characters and display the habits of both. These are the genus *Corythaix* and the genus *Musophaga*, the former inhabiting southern Africa and the latter the more tropical parts of that continent. They have partially the bills and wings of the poultry tribes, though from the forks in the sternum being less deep, and that bone in consequence stiffer, they are birds of more continued flight. Their chief relation to the climbing birds consists in the structure of the feet, which have not, however, the toes acting so generally two against two, as in the birds which properly belong to the order, though the exterior so readily admits of a reversed position. They are tree birds nestling in holes; and the one which is known in southern Africa is chiefly a vegetable feeder, feeding upon wild fruits. It is a bird of beautiful plumage, bright green, with some of the quills crimson, and an elegant crest on the head. It has sometimes been classed with the cuckoos, apparently from the structure of the feet; but there appear to be but slight grounds for warranting such a conclusion.

Great allowances must be made for mistakes and errors in the classification, and even in much of the description, of the birds which Cuvier has brought together in this order. With many of them we are abundantly familiar, but there are many others which inhabit only the depths of the tangled and almost impenetrable forests; and the manners of these are of course as little known as their haunts.

Cuvier's fourth order, the gallinaceous or poultry birds (GALLINÆ, or rather GALLINIDÆ, for the other genera have of course only resemblances to the common domestic cock (*gallus*), and are not identified with it), form in many respects a natural order; because though there are great differences of appearance and habit, and still greater difference of climate and haunt,—some, as the ptarmigan, dwelling only on the mountain tops in cold countries, and others, as the peacock and the jungle fowl, dwelling only in the wooded parts of tropical climates,—yet there is a general character which runs through the whole. They are not birds of powerful wing; and though many of them perch in trees, few or none of them find their food there. They are ground birds; and only cull the seeds of those herbaceous plants which they can reach when standing, and gather such other seeds, insects, worms, and various succulent or farinaceous vegetable substances, or often animal ones (for some of the genera are not very particular in that respect) as they find on the surface, but scrape up the rubbish with their feet, in search of such substances suited to their taste, as may be found under it. The march of the males is stately, and they are often very gay with ornamental plumage peculiar to their sex. They are all, however, heavy and laborious fliers; and make but little use of their wings, except when alarmed, or in reaching those perches upon which they pass the night secure from the attacks of foxes and other predatory mammalia which hunt during the night but do not climb.

The flight of the gallinidæ is so peculiar, that it might be taken as their descriptive character, with fully as much propriety as any other action is of a division of birds; and certainly with more than climbing can be as characteristic of the last order. The domestic cock, for instance, is quite a soldier in his wars; and like a *gallant* soldier (and he himself is the type of pugnacious gallantry as well as the original of the name) he fights for the honour of the victory, and not, like a mercenary, for pay and "provend." When he leads forth the dames of his seraglio to a public breakfast in the newly-expelled litter of the stable, his strut is quite Oriental, and might of itself lead one to the knowledge of his native clime; but when he attempts flight, there is a sad falling off; the bravery of the soldier and the strut of the bashaw are no more, and the lord of the dunghill vexes the air with encumbering wing, and flies less gracefully than a bat or a beetle.

This laborious and painful flight, for it is certainly laborious to the birds themselves, as they can continue it only for a short distance, and if it is not painful to them, it is painful to look at, is common to the whole order properly so called; and on this account Cuvier appears to have departed from his usual attention to structure as forming the basis of classification, in uniting the pigeons with this order. The pigeons are birds of powerful wing, and have as much command of the air as the true gallinidæ have little; and besides, the habits of the races are in almost every respect different from each other. Pigeons are monogamous, and though they breed often, each brood consists usually of only a single pair: the gallinidæ are in general, though not in all the species, polygamous, breeding once, or at most twice in the year, and their broods are numerous. Pigeons are, in many of the species at least, migratory, and they both migrate and associate in numerous, and, in some cases, in countless flocks: the gallinidæ are never migrants, and those species which are mountaineers, would rather perish in their alpine habitations than descend to any great distance on the plains; and when they associate with each other, it is at particular seasons rather than habitually, and in families, or at most in packs of a few families, and not in large flocks. Their daily range is indeed so limited, and they use the wing so little in seeking their food, that a very large flock of them could not subsist in the same locality.

Pheasants, though they have the same style of flight as the rest, are certainly not the worst fliers; and yet there is a very striking difference between the common pheasant and the common pigeon in point of capability of endurance in the same locality. Where pheasants are kept in numbers, a preserve is made for them, which is understood to afford them not only shelter, but the greater part of their food. Common pigeon-house pigeons seldom have any pasture preserved for them, and cultivators drive them off from their crops. The native habitations of vast numbers of the parent stock, too, are often in rocks or places comparatively barren, where they must range to great distances for their food—for pigeons require proportionally more food than the gallinidæ, and, indeed, than most other birds.

Now if pheasants and pigeons *naturally* belonged to the same order of birds, we might surely, under these circumstances, expect that the pigeons should suffer most from casualties. If not, there could be but small propriety in uniting the two families of birds into one order; for if there is nothing more of similarity in the several members of the order than that structure of organ, or habit, or whatever else it may be upon which the order is founded, then truly the formation of the order is a very idle matter on the part of him who establishes it, and a very deceptive matter to those who seek for information from it. The name of the order, or other group, should, no doubt, be founded upon one of the most striking coincidences in the genera that compose it; but if there are not other coincidences behind to which that one is the key, then any attempt to get information from the system will be somewhat like an attempt to get a knowledge of Macedonia from Fluellin's comparison between it and Monmouth:—"There's a river at Monmouth, and I'll pe pound there's a river at Macedonia; and they call it Wye at Monmouth, and it is out of my prains what they call it at Macedonia; but it is as like as my fingers to my fingers, and there's sawmons in them both." This, though not brought out with the same graphic exposure of its absurdity, is very often the kind of analogy which the systematists in natural history propound for the edification of mankind; and even the acute mind of Cuvier, which was less frequently bewildered than that of most naturalists, must have been lost in the fog when he united the pigeons with the gallinidæ.

To those who already know the characters and habits of birds, or any other animals, it is of little consequence in what juxtaposition the several kinds of them are presented; but those who have the knowledge to acquire, and resort to the system for aid in the acquiring of it, of necessity conclude that there is some general correspondence in the nature of those which are united in the same order, or other division; and if, as in the case of poultry and pigeons, there is really no such correspondence, they either waste their time in vain search after that which is not to be found, or they turn from the system (and, in part, from the subject) with disappointment, as promising that which it cannot perform.

The feet of poultry and of pigeons are both adapted for walking on the ground, and those of some species of both are adapted for perching: their bills, too, are both adapted for ground feeding, though not exactly for the same kind of surfaces or of substances; but when thus much has been stated, the parallel is nearly at an end. Thus far may be seen at first sight of the two; and when we come to study them more intimately, there is nothing, even of inference and analogy, in the general history of the one, that can lead us to the general history of the other.

The different casualties of the pheasant preserve and the pigeon-house show that, physiologically considered, the two races have little in common; that—independently of difference of power and style of flight, feeding, incubation, nesting and breeding, texture and flavour of flesh, and all other particulars—there is a difference in the whole nature of the birds, as they stand related to the course of natural events. The pigeons have, as has been stated, only a lodging in the pigeon-house, while the pheasants have both cover and food in their preserve—that is, not merely shelter while they are at rest, and accommodation for their nests, but food, and protection from the weather while they are gathering it. But under all the apparent differences of accommodation, the pigeons thrive best. As their numbers increase they extend the range of their feeding excursions; and though on these they have to use the wing much, and often to contend with the severity of the weather, they do not appear subject to any casualty of nature, but to thrive as well and be as healthy when they range over many miles as when they are kept at home and fed by the hand. The pheasants, on the other hand, cannot endure even their natural powers to increase beyond a certain limit; for (as was not many years ago proved at Wanstead, in Essex) if they are allowed, even in the most favourable preserve, to increase beyond a certain limit, *epizooty* falls on them, and they die by the score, not of hunger or any other perceptible cause, for they die in good condition, and the mortality continues till their numbers are reduced considerably below what would be left by a judicious sportsman.

Our native gallinidæ have not, perhaps, been so carefully studied; but there are well authenticated instances in which excessive preservation has been followed by, if it has not actually produced, epizooty, both in the mountaineers and the inhabitants of the plains. If such were the case only with pheasants, their foreign origin, and the many mild climates of which they are natives, might be alleged as the cause; but as the ptarmigan is the highest dweller of all our native birds, and the grouse live in more bleak places than the pigeon, and as they are subject to the casualty from which pigeons are exempted, we must conclude that the whole of the gallinaceous tribes, of which these are the most hardy, are physiologically different from the pigeons, and tempered to the elements in a very different degree. Taken alone, this would be a good argument against uniting the two in the same order; but when taken along with the structural, and even the textural differences of the birds, and the differences of all their actions and habits, it becomes irresistibly conclusive; and gallinidæ and columbadæ should unquestionably form separate orders in any system pretending to be natural.

If this is done, each of the orders becomes well-defined as well as natural; and they do not even clash or get confounded with each other on their confines, as is the case with many of the other orders. The structure, the action, the habits, and the general character, as inferred from the whole, are all so constant in each, and so different in the two, that if we know one genus well, we never can be at a loss with any other in the order; neither can we, in any instance, confound the two.

The fluttering and apparently painful flight of the gallinaceous birds may excuse a few sentences of explanation, as it is one of their most general and most striking differences from most other winged birds, and as the explanatory notice of it will throw some further light upon the structure of the organs of flight. This becomes the more justifiable, because the more necessary and useful, when we consider that the superiority of the flesh of the gallinidæ to that of all other birds, as human food, if not dependent upon, is at least intimately connected with their imperfect power of flight.

When we speak of the flesh of any animal as an article of food, it is always the muscular part of the animal which is chiefly understood. We cannot exactly estimate the power of muscles upon common mechanical principles, because the energy of life in the animal to which they belong is always an element, and one which we can subject to no calculation. But the quantity and texture of the muscle are also elements; and though we cannot say that the power of action varies exactly as any one of them, or as both jointly, yet it does increase with their increase and diminish with their diminution. Now, air birds, whose action is chiefly performed by the wing, have almost the whole muscular structure of their bodies concentrated upon that; and if they have to remain long in the air, and contend with the wind there, the structure of the muscles is proportionally rigid, and they are, of course, difficult of mastication and digestion. In these cases, extra dressing, whether by the action of the dry fire or by boiling, does not cure the evil; for though these muscles become more easily divided in proportion as they are more dressed, they become at the same time, and perhaps in a greater proportion, more dry and tasteless, and less digestive and nourishing. A dinner of the pectoral muscles of well-seasoned eagles, or the larger hawks, would be serious labour for the jaws of even the most willing masticator; and bating the bitter taste, a rook of five broods would make almost as tough a meal as oakum or old junk. These qualities decrease as the birds make less use of their wings; and in those birds which are not allowed to fly at all, while fattening for the table, the muscle is more juicy and tender than in any others. But that preparation may be overdone, by the bird having less exercise than accords with a healthy state of its system, and then what is gained in tenderness and even mass of flesh, is more than lost in flavour and wholesomeness. If the inactivity is unnatural and the food abundant, the tendency is an over-production of fat; and the fat of birds is the least wholesome of all fat. It consists chiefly of *elain*, and not of crystallisable fat, and as such it very readily passes into an oil, difficult of digestion and very much disposed to become rancid. A barn-door fowl, which roams freely as it lists, enjoying plenty and variety of food, and clapping its wings and flying a little if so inclined, is, in point of flavour and wholesomeness, worth all the penned birds that ever were "prepared for the market." This is, as nearly as can perhaps be obtained in Britain, the natural state of the bird; and though there is no doubt something of the influence of name in the matter, the fact of their living and feeding in a state of nature is one grand cause of the preference given to the wild gallinidæ. But the flesh of these also is tougher and more dry in proportion as they are more in the habit of using the wing; and therefore if they cannot be dressed before they stiffen at all, they require to be kept till incipient putrefaction makes them tender; and when they are very high, the organs of taste and smell sometimes have disputes about their real worth.

Thus, the qualities which the flesh of the gallinidæ derives from their small tendency to flight, renders them more immediately valuable to man than any other birds; and the very same circumstances, taken in conjunction with their other habits, render them among the most easily obtained. They are also among the most prolific, and instead of vanishing before the progress of culture, as is the case with many other birds, they increase in proportion as man cultivates the ground. The partridge comes where man ploughs, and in proportion as he plants, pheasants increase in numbers.

The chief use of the wings of the gallinidæ, besides enabling those which perch during the night to reach their perches, appears to be safety against quadruped foes. Their fluttering gets them, perhaps, sooner above the reach of these than if they had a more steady and forward style of flight. From birds of prey they may be said, one and all, to be incapable of escaping on the wing; their safety from these consists in crouching among the clods or lurking among the herbage; and their general colours are such that they are not easily distinguishable from these. Their wings are short, broad, and concave, and they are also looser in the plumage of their under sides than the wings of almost any other birds. All these qualities make them take a great hold on the air, which assists them in "working upwards," though it renders even that direction of flight more laborious. They can thus reach the height of escape from a ground preyer, or that of perching, upon a more perpendicular line, or with less forward motion than birds of more powerful wing. The same form of wings enables them to drop down more readily than almost any other birds, except those which, like the sky-larks, drop from a great height, and acquire an impetus from the descent. This power of quick descent is as advantageous to them as that of speedily rising, for they drop so quickly into their cover that one can hardly point to the precise spot, and the difficulty of so doing is increased by the wheeling motions which they have when in the air, and also by their running in a different direction from that in which they were flying, before they squat, or otherwise pause, for the purpose of hiding themselves.

Thus their apparently clumsy and ungainly wings are as well adapted to their peculiar habits and haunts as the finest and firmest wings that cleave the air. It is also worthy of notice that, as their power is not concentrated in the wings, but diffused over the body, all the parts of which have more or less of motion in their several actions of walking, running, crouching, standing up for observation, and others, the whole body comes more into action, and labours more during their flight, than in the more elegant fliers.

This is an instance of a very curious habit of the bodies of animals, which is so general that man himself is not exempted from it. It is this: if any one system of the body, be that system what it may, whether external or internal, is to work in its most graceful and efficient and least laborious manner, it must work alone, and the rest of the body must be trimmed to its accommodation, and not in a state of excitement or action. This is a proof that the principle of animal life in the individual is one, in the same manner as the intellectual principle in man is one. If the breathing, or the circulation, or the digestion, labours violently, the external organs become unfit for motion; and if the whole body is excited, no one organ of it can perform its function so well as if the rest of the body were tranquil. In man, this is called self-possession, coolness, or firmness, and every one knows its value; in other animals it arises from a different cause, but its effect is nearly similar.

We find the difference between the wholly excited and acting body, and the acting of one part only, with the others trimmed or borne in accordance with its action, well exemplified in the spring of the lion or the tiger, and the stroke of the falcon. In the beast, the impetus is given with the whole body; in the bird it is given with the wings only. Thus it is momentary and exhausting in the former, but in the latter it may be continuous, with comparatively little abatement of energy.

The flight of the gallinidæ may be regarded as only a sort of semiflight. It is performed with the whole body, and partakes of the exhausting character of every motion so performed; and the faster that these birds attempt to fly, they can fly for the shorter time: they never fly fast but when they are excited, and they very frequently scream as well as flutter, showing thereby that they are in a state of unnatural excitement—that such flight is not their natural habit.

And when we examine their structure, we find that the whole body must act when they fly. The deep forks or clefts in the sides of the sternum, render that bone flexible; the form of the furcal bone, which is that of the letter Y more than that of an arch, and with the branches not placed with that side to the strain with which they would be stiffest; and the looseness of the blade-bone; all conspire to render the socket of the humerus unsteady and capable of play in all directions. The whole side of the animal thus works in lessening the effect of the wing-stroke, and at the same time fatigues the bird more than would be done by a firm wing. The muscles are also, as has been noticed, of less firm and enduring texture, in proportion to their bulk. Thus the gallinaceous bird is, by its structure, kept to its element as an inhabitant of the earth, and rendered incapable of soaring with the air-birds, to share either the grandeur of their flight, or the dangers to which they are exposed on the wing.

But while the loose and fluttering wings of these birds keep them to their own element and place in the world, they are not less adapted to their habits and necessities there, than the swiftest and most enduring wings are to their different element. We have already mentioned how well they are suited for escaping the foe or gaining the perch; and the looseness of the scapular socket is not the least beautiful part of their adaptation. The haunts of the birds are among shrubs, and bushes, and tall herbage, and they have often to use their wings and get quickly above their ground enemies from among these. They have also to close their wings among interruptions, and with as little rustling of the wing or that which disturbs it, as possible. The broad wing and the loose and moveable nature of its articulation, answer another purpose in the economy of these birds, which though not so immediately important to the individual, is equally so to the race: the females gather their young under their wings in the early stages of their existence. This protection of nature appears to be necessary, as the young of these birds are but lightly covered with down, as there is no formal nest for them, and as they are, even in the perching species, unable to perch till they are fledged. They have, however, more use of their legs, more general activity, and are better fitted for finding their own food when they have the skill, than the young of any of the preceding orders.

This state of the young when produced, corroborated as it is by their general structure and habits, very clearly points out the place of the gallinaceous birds in a natural system of arrangement. If the birds of most powerful wing, and of which the air is the principle element—the races which most perfectly answer the definition of the term bird, in being most exclusively dependent on their wings,—are to be placed foremost in the system, as they unquestionably ought to be; and if the gradation is to be regular from them to the races which are wholly dependent on the earth, and can neither fly nor swim, and proceed from them to those which are wholly dependent on the water; then, unquestionably, the proper place of the gallinidæ is immediately before these ground birds, which have less power of flight than they, and after the pigeons.

This mode of arrangement, as we shall attempt to prove in a short induction from the particulars, after we have given an outline of the remainder of these, is borne out by a regular gradation in all the leading habits of the several races from the time that they leave the shell till they become parents, and display those instincts which complete their mature character in the way in which they provide for, or otherwise treat their young. There are apparent anomalies in such an arrangement, because at some parts of it there seem blanks, where the characters of the one division do not meet those of the next one so as to preserve the continuity; and there seem at other places to be redundances, where two races, different in some of their characters and habits, have others so much in common or so equally, that it is not very easy to say which ought, in strict propriety, to be placed first. In some instances, these wants and redundances, these breaks and doubles in the chain, so to speak, exist only in our partial view of the matter. But when we consider that birds, in one or another of their varied tribes, inhabit the whole land and sea, and that the characters of these are, in some places, uniform over a considerable range, and in others constantly varying; that some are exuberantly productive, and others bordering upon sterility; we may easily see that the birds must crowd both in species and in numbers to the places of abundant and varied production, and be fewer and more uniform where food is scanty and nearly all of the same description. The natural series of birds is thus not one which can proceed by uniformly equal distances between race and race, but by distances varying with the haunt, and the varying abundance of the food for them, whether local or seasonal.

Cuvier's fifth order, which is a very numerous one, and includes birds very varied in their appearances and habits, is that to which he gives the name of Echassiers, or, "stilt birds,"—birds, generally speaking, with long legs, all capable of walking, and many of them fleet in that motion, but varying much in their powers of flight, and also in the shape of their bills, according to the nature of their food, and the places in which they seek it. They are otherwise styled *Oiseaux de rivage*, birds of the water's edge, bank birds, shore birds, *grallæ* or waders, and *grallatores*, or *grallideæ*, birds resembling wading birds. They are also sometimes divided into two orders or sub-orders, *Cursores* or runners, and *Grallidæ* or waders. But no name, whether founded on one haunt, habit, or peculiarity of structure, as all of those are, will suit the whole, neither can any general definition or description be so framed as to be explanatory of the whole.

There are few or none of the orders already mentioned, which do not reach the water's edge in some of their genera; and even the most aquatic of the sea-birds are reared on the shores, and compelled to seek the shelter and safety of these when the ocean is in its fury. Some of the eagles fish; some of the omnivorous birds seek their food within flood-mark when the tide ebbs; the swallow tribe skim the surfaces of pools; almost all the *syndactyli* live in holes in the banks, and the king-fisher is named from the manner in which it finds its food; even the common pigeons are found wild in sea-beaten cliffs; and one species at least of gallinaceous bird, has the feet partially webbed, and frequents marshy places. When therefore we speak of a "bank bird," our expression is exceedingly vague, unless we go on to explain at length how it is employed on the bank, and that explanation would give us the information as well without the name as with it. This is therefore a portion of the class, and it is a large and important portion, which is not clearly set forth in the system.

The distinctions of runners (*Cursores*), and waders (*Grallidæ*), are applicable and definite enough, as expressive of the extremes of the order; but as walking and wading are motions of the same kind and performed with the same organs, only with a difference of the element, and a difference of the organs to adapt them to these. But they interfere on the confines; and there are some, indeed many, of the species which perform their ground motions so equally on the land and in the water, that they cannot with propriety be considered either as walkers or as waders. If, however, we separate those species which have no aquatic habit, but are found upon dry places only, and they are habitually found upon pastures more arid than any other ground birds, and consider them as Cursores (for they are all swift of foot, and the majority of them are incapable of flight), making them a distinct order; and then include all the others in another order Grallidæ, or birds which can and occasionally do wade, we shall perhaps come as near to accuracy as is possible without a much greater, and indeed an inconvenient number of primary divisions.

Cuvier divides the order into five principal groups or families, to which he has to append some genera which do not conveniently come within any of the groups.

The first group, *Brevipennes* (short-wings), consists of the ostriches and other land birds which cannot fly; but the name is not very accurate: and the group to be natural and preserve the gradation should include some birds which can fly, such as the bustards, which form the connecting link between the gallinidæ and the ostriches.

The second group, *Pressirostres*, includes those birds which have the bill hard and compressed laterally; and which are long on the legs, and have the hind toe wanting or merely rudimental. Some of them are bank birds, but none of them wade deeply in the water; and their proper character is that of running birds. In a natural arrangement, some of them should precede and some follow the ostriches.

The third group, *Cultrirostres* (knife-shaped, or ploughshare-shaped bills), is pretty natural, though the epithet does not express the shape of the bills of many of them. They are, in general, long-flighted birds, ranging far and wide, especially in those countries which are subject to alternate drought and inundation. Many of them are true waders, and perhaps the most typical birds of all the grallideæ.

The fourth group, *Longirostres* (long-bills), is also tolerably natural, though the single epithet "long" is hardly sufficiently expressive of bills of so many different shapes and textures, as are possessed by these birds. Some genera of this group have so much the habits of the former, that there is a very natural transition from the one to the other; but very many of them are marsh birds, seeking their food in boggy earth, sludge and ooze; and these in general have the bill flexible, and provided with nerves and vessels, so that it is a more sentient organ than the horny bills. As these find their food more by the touch of the bill than by sight, they are often nocturnal or twilight feeders, and remain in the cover of the tall aquatics or marsh plants during the day. On this account they are often really resident in places from which they are supposed to migrate.

The fifth and last group, *Macrodactyles* (large-toes), differ more in their characters in proportion to the number of the genera. They are, as it were, on the confine of the order, and begin to partake something of the swimming character. This is the case with the *coots*, which have the feet lobed, and so articulated that they are not very efficient for walking. There are others, again, which, though they are not found in arid places, can hardly be said to be aquatic in any of their habits, or even to resort to the margin of the waters, of which the common corn-crake is a familiar instance. These, and some others, have considerably more affinity with the gallinidæ than many of the other genera, and even groups, which are interpolated between them in the system. The pratincoles, flamingoes, and some other genera which Cuvier appends to this group, without meaning it to be understood that they naturally belong to it, are also of a mixed character. The pratincoles have at least some of the characters of those insectivorous birds which have syndactylic feet, and also some of those of the gallinidæ; and it does not appear that, though they frequent the margins or surfaces of the waters, they are in any respect wading birds. It is also not very easy to assign the proper place of the flamingoes in any system which pretends to be quite natural.

We must not, however, either wonder, or be perplexed in our inquiries, at these apparent anomalies. It has been hinted, that the rich places of nature are those at which birds appear to interfere with, or, if the expression may be allowed, to *overlap* each other, agreeing in some of their characters, and differing in others; and as the margins of the waters are the richest places, and the places which are most permanently rich in the food of birds, it is natural to expect that upon these there should be the greatest interference of race with race, and consequently the greatest difficulty in so separating them from each other, as to give distinctness to their systematic arrangement.

Palmipedes, or webbed-footed birds, form Cuvier's last order of this class; and in so far as that they can launch themselves upon the waters, and be in their element there, they are a natural order. But they are not the only birds which can swim, for some of those of the former order can swim readily, and others can do it occasionally, although their feet are not webbed, but have only partial membranes, more or less produced, attached to their toes.

If we were to take a regular gradation in the birds of this order from those which have the feet the least adapted for acting upon the water, to those which have them the most so, we should begin with those which have the toes only lobed and margined, and proceed to those which have all the four toes united by one membrane or web. But the other active systems of the birds interfere with this arrangement, and their varying powers of flight interfere with the classification which otherwise might be founded on the structure of the feet, and render it imperfect.

Aquatic birds have wings of very varied structure. Some have about the longest and most powerful ones of all the feathered tribes; some have them short and round, and some are almost wingless, though there is no sea-bird so completely so as the apteryx. Their wings are also used for very varied purposes. Some use them habitually in feeding; some in ranging the surface of the ocean; and some chiefly for migration from place to place, as changes of season and of food may require.

Their bills vary nearly as much in structure. Some have the form of spears for transfixing fishes, upon which the birds dash from a considerable height; some are toothed in the tomia, for catching the finny prey as they drive through the waters; some are fitted for cutting and tearing the carcasses of the larger sea animals, which are often floating dead on the surface; some are adapted for collecting oil on the surface of the waters; and some for dabbling in the mud on the shallows.

Organs so differently formed, and applied to so many purposes in so many ways, render the division of aquatic birds into natural groups no easy matter, though some of the groups are as distinct and well defined as any of those of the land birds. Cuvier arranges them into four tribes.

The first of these consists of *Divers* (*Brachyptera*, or "short wings"), which have some affinity with the shortest winged and most aquatic of the bank birds, and they run on, becoming more and more birds of the water, and less birds of the air or the land, till those species are arrived at which can neither fly nor walk. The show of resemblance may be said to run to a termination in this group; for, as the last ones can only swim and dive, and there are no other birds which can do either in greater perfection, there is no point of general character upon which any others can be connected with them. The popular name is also not quite precise, because, though they are probably the only birds which drive through the water, they are not the only divers.

The second group, Longipennes (long-winged birds), agree well with the name in that part of their organisation to which it applies. They are the birds which career over the surface of the ocean, and make the shores lively with the motion of their wings, and clamorous with the sound of their voices. Their food and their manner of obtaining it differ so much, however, that they do not admit of any general description.

The third group, Totipalmæ, or birds with the feet "entirely webbed;" that is, having the hind toe considerably produced and included in the membranous web, as well as the other three toes. These birds are much longer winged than those of the preceding group, and they are good swimmers, and some of them at least can dive; but the peculiar structure of their feet, and the use which they make of these in walking up to the surface of the water after they have plunged into it from a considerable height, render them very distinct from the other sea birds.

The fourth and last group into which Cuvier arranges these birds, Lamellirostres, or flat-billed birds, comprehending ducks, geese, swans, and allied genera. There are considerable differences of haunt and habit among them; but still they are distinct, and well-marked as a group. But it is doubtful whether they should occupy the place which Cuvier assigns them, as they more resemble the divers in all their general characters than they do the birds of the two intermediate groups.

Such is a short outline of the systematic arrangement of birds, as proposed by the most scientific general systematist of modern times. Many parts of it are imperfect, and some are obviously faulty; but the imperfections are much more easily felt than amended, and the faults much more easily seen than corrected. These imperfections and faults are also of the less importance, inasmuch as it is in the individual genera, or, at all events, in groups much smaller than most of those which have been mentioned, that the real history of birds must be studied. We shall now, in three successive sections, shortly examine and compare the bills, the feet, and the wings of birds, as the foundations of their leading characters.

V. Comparative forms of the bills of birds. The armature of the jaws of birds, which answers the same purpose in their economy which the lips and teeth do in that of mammalia, always consists of two mandibles, one placed over the other, and opening and shutting chiefly by the motion of the lower one. This organ is sometimes called a *bill*, and sometimes a *beak*, but the distinction of these names is not very clear. Bill is, however, the more general of the two, in the usage; for all beaks may be called bills, but all bills cannot be called beaks. According to the popular understanding, which, rather than any etymological definition, is the rule in popular language, the mandibles of a bird, in order to entitle them to the name "beak," require the three attributes of firmness of texture, power, which requires considerable depth and breadth in proportion to the length, and curvature downwards, with pointedness at the tip of the upper mandible, and projection of it over the under one; but the precise degree in which these are required, as well as their relative proportions to each other, is indeterminate. Those to which the term beak is more generally applied are the mandibles of birds of prey, and those of the parrot tribe, and some other vegetable or omnivorous feeders which use this organ in breaking hard substances, or in assisting in the operation of climbing.

All beaks, whether used for one purpose or for another, have a considerable resemblance to each other, not only in the shape but in the mode of using. They are always cutting or bruising instruments, the effect of which is produced by pressing the one against the other, and not by striking with the point or darting, as is the mode of action in many bills. The form of the tomia or cutting edges, are therefore the leading distinctions of different beaks, and the indexes to the different characters of the owners in so far as these depend upon those instruments; though there are also some corresponding differences in the shape and strength. In the tomia of beaks there is a slight resemblance to the teeth of animals, as indicating the nature of their food. Those which are carnivorous have the tomia irregular in their outlines, approaching in form to something like a tooth; and those which are more exclusively vegetable feeders, have the lines of the tomia less broken, and the acting surfaces adapted simply for breaking or bruising rather than for tearing asunder. Some of the latter are, however, more strongly formed than any of the former; because the shells of some fruits upon which certain species at times feed, require more force to break them, than is required to tear the average consistency of the flesh of animals, even in the most recent state. But the bills of the most vegetable feeders have little or no lateral motion by which they can prepare the food for the stomach by grinding; and that appears to be the chief reason why birds of this description always have muscular gizzards, strong in proportion as their food is more difficult of division.

These characters of the tomia belong to bills as well as to beaks, though bills have in many instances additional characters, such as being serrated, sometimes with little teeth reflected backwards along the whole line of their margins, and at other times with small transverse channels, or furrows, along a certain breadth at the margin. The first of these descriptions belongs principally to birds which dart upon fishes, or other slippery prey; and the latter to those which dabble in the sludge, and, as it were, sift the water and mud from their food by means of the channels. The former are generally hard in their consistency, so that they may penetrate and retain their hold like barbs; the latter are more frequently soft and flexible, and there is reason to believe that they are endowed with sensation, by means of which they can distinguish the food from other substances, and thus retain the one and reject the other.

Bills are, however, of so many forms, and so different in the texture of their substance, that no general definition can be made descriptive of them. If omnivorous, they are generally stout, sharp at the tip, and with ridges on the culmen, or centre of the upper mandible, and also often at the tomia of both; and these ridges, which render the bill much stronger and stiffer than if the same quantity of horny matter were equally distributed over the entire surface, often give a quadrangular form to the section of the bill. Bills which dig into the bark or wood of trees, into hard ground, or into other substances which offer considerable resistance, are also provided with ridges. This is the case with even those very small bills which pick minute insects and larvæ from the crevices of bark, and thus such bills are often much stronger than others, which, having a larger diameter, look more formidable. All bills, too, which are used in striking or thrusting with the point, are fortified by ridges, and such bills never have so much curvature in their general shape, as that the line joining the tip and the centre of the base falls anywhere without, or even near the surface of the bill. If they act both by thrusting and by cutting between the edges, the ridge of both mandibles is usually a little arched, the arch in that part being the form which, with an equal quantity of matter, enables the mandibles to compress any substance between them with the greatest force. But if the thrust be the only powerful action of the bill, the ridges of the mandibles are generally concave, with the curvature increasing towards the base of the bill, something in the same manner as that of the bole of a tree increases near the surface of the ground. This is the outline of greatest stability, and as such it is adapted for lighthouses and other structures which are much exposed to strains from the action of the wind or the waves. In those bills, this enlargement toward the base, over which the tip is generally situated in a perpendicular line, causes the bill to strike with more precision, and also with much less jarring of the cartilaginous substance by which it is united to the bones of the head than if it had any other form. Thus we see that in those organs of birds which have not generally any sensibility or proper motions of their own, the same mechanical perfection is displayed as in the more sentient or more active parts.

We need hardly say that the bill or beak is adapted to the general structure of the bird, because all the parts of every organised body, be the organisation what it may, are always the best adapted to each other, and to the whole; but there are certain other parts of the structure with which the bill has a more immediate agreement If the bill has to tug and wrench in tearing asunder the food of the bird, the neck has always great strength and great power of lateral motion united. If the bill has to strike forwards, the neck admits of less lateral motion; but it moves the head in the direction of the stroke with great celerity. Thus the blows of the woodpecker are given in such rapid succession that the motion of the bill can hardly be seen, or the strokes counted; and though the neck and bill of the heron tribe appear unwieldy, they strike out with amazing rapidity.

The adaptation of the bill to the other acting parts of birds depends, however, in no small degree upon their habits; for, after all, it is to the habit that the whole parts of the bird are adapted. Thus, though the taking of the same food, generally speaking, requires a bill of the same structure in its working parts, yet as that bill is brought within reach of the food in different ways, and by means of different organs, it must be so modified as to accord with these.

If the principal action of the bill consists in detaching the food or breaking it, it is always short, or only of moderate length, and stout in proportion to its length; if the bill is used in hewing or digging for the food, it is longer, straight, and hard and pointed at the tip; if it bores into sludge, it is still longer, straight, broader at the tip, and generally sentient, so as to discover eatable substances by touch; and if the bird feeds in the free air, or on the clear surface of the ground, the bill is, in general, of moderate length. But all birds which capture living food, either in the water, or concealed among herbage, by a sudden thrust of the bill, have it long.

There are other purposes to be answered by the form of the bill besides the mere capture of the food, and adaptation to the place where it is, and the manner of getting at it. It is a general law in the economy of animals, that they shall be safe while they are feeding, at least from dangers connected with the food itself, or the place where it is.

Now, besides being pruners and weeders to the vegetable kingdom, and a sort of general scavengers for removing the waste of all nature, birds appear specially appointed for keeping within proper bounds the numbers of fishes, mollusca, insects, and reptiles. The power of production in all of these is very great; and, with the exception of the fishes, which settle matters by eating each other (often their own species), this productiveness is far above the average support, or even the room which there is for them in nature. The tadpoles which appear in one brook would, were they all to live and breed, speedily cover a county with frogs; the caterpillars on one branch would, if so breeding, soon clear a forest; and the snails would speedily multiply till not a green leaf were to be found. The ophidian and saurian reptiles are, in many of their species, co-operators with the birds; but they frequent the places where the food of birds is abundant, and they are not fitted for long migrations. The motions of molluscous animals are proverbially slow; and though many of the insect tribes are clever on the feet, the wing, or both, they are not capable of long journeys. Locusts and some other tribes do migrate; but no insects can continue long on the wing. They want the feathers, the characteristic organs of long flight; and though their muscles act to very considerable advantage, they must move their wings so incessantly that they are soon worn out, and fall to the earth.

There is here a very beautiful chain of adaptations, which is worthy of study in itself, besides being intimately connected with the general economy and structure of birds. All these natural trimmers of the exuberance and removers of the waste of growing nature are wanted up to the full amount of their powers. But they are so wanted only for a season; and though that season varies in length in different latitudes and climates, there is not a spot on earth where it could be perennial, or even of one whole year's unbroken duration, unless the laws of the whole system, that is, the qualities of the several parts of which it is made up, were totally changed. The vegetables could not bring all their "briards" and buds to maturity, nor would the earth supply sowing ground for all their seeds; and the creatures, of whatever kind, which keep down the superabundance of these, would, in like manner, speedily overstock the room that there is for them. But still they must all have that elasticity by means of which they can instantly adapt themselves to the changes of the system. The earth consists of a definite quantity of matter, occupying a definite space; and to that quantity and that space all the productions of the earth must be capable of accommodating themselves, otherwise the system would be imperfect.

The earth itself is, perhaps, at once the best index to the system of the earth's productions, and the best illustration of the mode in which that system works. It careers round the sun, altering its distance from that luminary, and the rate of its motion, every moment, and differently affected as its own attendant moon, or any other body in the solar system, is differently situated with respect to it. But though *altered* it is not *disturbed;* the balance is never deranged, and we are so far from feeling the inequalities of its motions, that it is only after the most profound investigation that we become aware of their taking place. The law which God has given it is a perfect law; and no case can arise to which it does not apply with the same ease and perfection. If the motion requires to be accelerated or retarded, in order to keep up the perfect balance, the very necessity for the change is, in itself, the cause of that change; and, be the aberration ever so much, there is always a principle inseparably connected with it, which, in due time, produces a return.

Just so with the growing and living productions of nature; if the general circumstances are such as to harmonise with an increase, there is no waiting for that increase as man must wait in his workings, and no toil as he must toil to bring it about. The necessity and the supply come so simultaneously, that the one cannot be called the cause and the other the effect. They at once prove their origin from the same cause; and that that cause is no part of the system of nature, although intimately familiar with it all in extent and in duration.

The preservation of the whole system of nature requires that, at certain pauses, and those not very wide of each other, the races which, among their other uses, put the birds in motion, must be as "the dry bones in the valley of death;" but the Author of nature has so ordered that, when their activity becomes necessary, there is "a spirit" breathed by them into the system, which can, unseen, and in an instant, pass over them and recal them to life and activity. Thus the cold winter of the polar climes, and the withering drought of the equator, are alike necessary for preserving the energy and the beauty of the world.

All preyers, and birds in an especial manner, as being the most discursive rangers, are highly valuable. They give play to the energy of life generally in that which they individually destroy; and but for them the earth would become rank and foul with the carcasses of those tribes which must perish and be renewed in the different seasons.

In the performance of these labours, many species of birds have to prey upon animals, the immediate contact of which with the body of the bird would be attended with fatal consequences; and in other cases the prey is in places which the bird cannot, with safety, approach too closely. The parts of birds which are naked of feathers, whether they are covered with horn or with skin, contain few muscles or blood-vessels, so that they are not easily wounded or otherwise injured in such a manner as to affect the general economy and action of the bird. This is the more necessary on account of some of the creatures upon which the birds feed being capable of inflicting poisoned wounds, all of which would be painful in the fleshy parts of the bird, and some of them very speedily fatal. It does not appear that the animal poisons, known by the general name of venom, are deadly, or even in the least injurious, if they are not taken into the circulating blood. Whether they must be so taken by direct introduction into a blood-vessel, in order to produce their fatal effects, or whether the poison may be carried into the circulation by the lymphatics, which pour what they collect into the veins through the thoracic duct, is not clearly ascertained; but as the effect of those poisons always shows itself locally, near the place of the wound, before it injures the system generally, it is probable that a direct mixture of the venomous fluid with the blood is necessary, in order that it may produce its destructive effects; and this is rendered the more probable from the fact that the same fluid may be taken into the stomach without the smallest injury, by animals to which it would prove fatal in a very short time if taken into the blood.

Many birds feed upon creatures provided with poisoning apparatus,—as the bee-eaters and other species feed upon many insects that have poisoned stings; and various species of birds feed upon serpents which have poison fangs. Now, all those birds are so constructed, that those parts of their bodies which could be seriously injured by the sting or the fangs, are kept out of the way. If, like the bee-eaters, they capture stinging insects on the wing, the bill is long, and the tongue either short or indurated, so that no part of them which comes in contact with the insect, is liable to be hurt by its puncture or its venom. In those species which eat poisonous snakes, the bill is long, and the tarsi also, so that all those parts of the bird which are vulnerable by the reptile, are elevated above its reach after it is once pressed to the earth by the feet, when it is not at once killed by the stroke of these on the head, which is a very common habit with birds in the case of such prey. If food which is thus dangerous is taken by the bird on the wing, as is the case with wasps and other venomous insects, the bill is long, and the tongue either short, or callous towards the tip, so as not to be very liable to injury, if the snap of the bill, which however is seldom the case, should fail in despatching the insect.

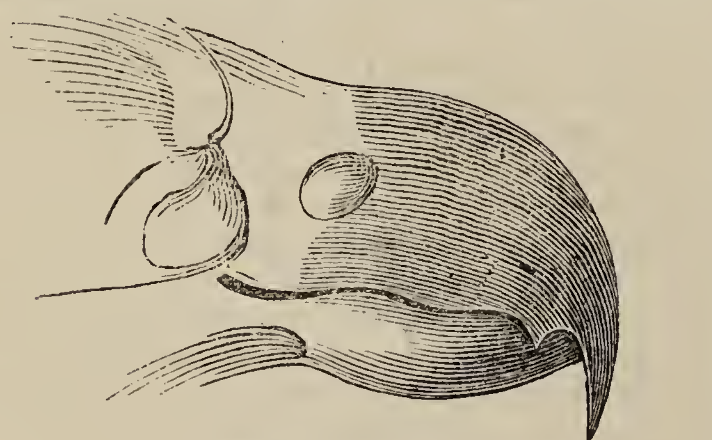
If the food is in itself harmless, and not liable to escape rapidly, so as to require a quick dart of the bill, that organ is short, and any inconvenience which may arise from the distance at which it is below the level of the body, or from the difficulty of the surface on which it is found, is usually got the better of by the length and flexibility of the neck; but as a long and flexible neck is neither so steady nor so quick in its motions as a shorter one, the bill and neck are seldom both long unless in those species which take their food from the water, by darting rapidly on it by an aim taken when the eye and head are above the surface. Birds of this structure usually find their food on the margin of the water, or in the shallows; and there is hardly any instance of a bird which feeds on the wing, having both a long bill and a long neck.

The same observation applies to birds which seek their food while launched on the waters. Swans, geese, and those ducks which never get wholly below the surface, though they get with the head perpendicularly under them, and hang, as it were, upon the water by means of the feet, have the neck, and generally also the bill, much longer than the divers which plunge wholly under water; and the legs of the latter are articulated more in the rear, which makes them more efficient organs of motion through the water; but the birds could not recover their horizontal position on the surface, by means of them, so easily as those swimmers which have not the habit of diving. Those ducks which do not dive, turn on the articulations of the legs, and bring their heads to the surface with very little progressive motion; whereas the divers rise head foremost, and always at some distance from the place at which they plunge. The common duck gets the head down chiefly by the action of the neck; the plunger by a swing upon the webs of the feet, the whole length of the body acting as a lever. The diver, too, can make the body follow the bill, as guided by the eye when under water; and the bill is compressed, or at all events narrowed and rounded at the tip, so as to make it readily available in that action; whereas the bill of the dabbler, which does not dive, is probably available only in the sludge, and incapable of capturing prey that can move swiftly. Dabbling ducks rarely capture even the fry of fishes, in those shallows which they frequent; but these are the principal food of many of the divers.

The bills of birds are, however, so much in harmony with the other parts of their organisation, that it is impossible by any description, however lengthened, to give a clear and satisfactory notion of them, even in their leading function of feeding instruments. They have, in many species, other offices to perform; and though these are subordinate to the alimentary function, as the functions of the mouths of all animals are, yet the bill must necessarily vary with every natural operation to which it is applied.

The secondary functions of bills are chiefly preening the feathers, climbing, constructing nests, and defensive or offensive operations not connected with feeding. These functions are performed with so apparently equal ease by bills of so different forms, that it is not easy to say which answers the best; and then the comparative merits of bills, as working tools, can hardly be so generalised as to convey any information useful to the student of ornithology. We shall therefore proceed to give some instances of bills belonging to well-known or well-marked species, as illustrative of the several orders.

Bills of the Accipitres.—The annexed figure of the bill of the jer falcon may be regarded as the most



Jer Falcon.

perfect type of those of diurnal preyers upon the wing. It is short, compressed, and so formed on the culmen that it is perhaps stronger in proportion to its size and quantity of matter, than the bill of any other bird. The tooth is prominent, the notch well defined, and the tomia curved in the greater part of their outline. The form of the tip of the lower mandible is peculiar, acting with a sort of sliding motion against the hook of the upper one; and this sliding motion is in part communicated to the tooth and notch, and to all the irregularities in the lines of the tomia. The action of the mandibles is, in consequence of this form, compounded of the direct cut of a chisel and the drawn cut of a knife. We shall find the same sort of action, partially at least, in some of those sea birds which live much upon floating carcasses, though in these it is a simple slide at the tip, without any notch or tooth.

This is not so much a killing beak, as a tearing one; and it answers in the economy of the bird, to the tearing grinders in carnivorous mammalia, the claws performing the operation of killing in the falcons, just as the canine teeth do in those. It is not suited for thrusting or striking; and therefore it is not so formidable as a weapon as some of the straight bills; but it takes a very firm hold; and there is no soft part of an animal which it will not divide with the greatest ease. It is also well formed for pulling feathers; and by means of it the falcon can deplume her game, as neatly, and with as little injury to the flesh, as the most expert poulterer. It can also cut open the birds, divide the tendons and ligaments, and when scarcity of prey renders economy necessary, it can separate all the joints, and leave not an atom of eatable matter on the bones.

In proportion as the different species of falcons and hawks have the bill approaching to this typical one, they are preyers on the wing, and consequently preyers upon birds, killing their own game, and eating it in the recent state. In proportion, too, as they have this structure of the beak more perfect, they fly at "higher game," or birds of more powerful wing. The plumage of these is more firmly set, and the tendons and even the muscles are much tougher than in birds of lower flight; and besides, the low-flying hawks, harriers, and buzzards, strike prey upon the ground; and prey upon small mammalia, or occasionally take a mess of carrion or garbage.

It is thus not without some shadow of reason that the high flying falcons were called "noble," and the low-flying ones "ignoble;" for there is a sublimity in their style of hawking, as compared with that of the others. They are the genuine birds of prey; for though they descend to the earth to strip and eat their game, their preying is, in a state of nature, confined to the air, the appropriate region of birds.

The peregrine falcon is probably next to the jer; but the gradation in the beak is not very strongly marked among the high-flyers; for the smaller ones, such as the merlin and the sparrow-hawk, have it very beautifully formed, better adapted certainly for dividing and tearing flesh than any instrument of human contrivance.

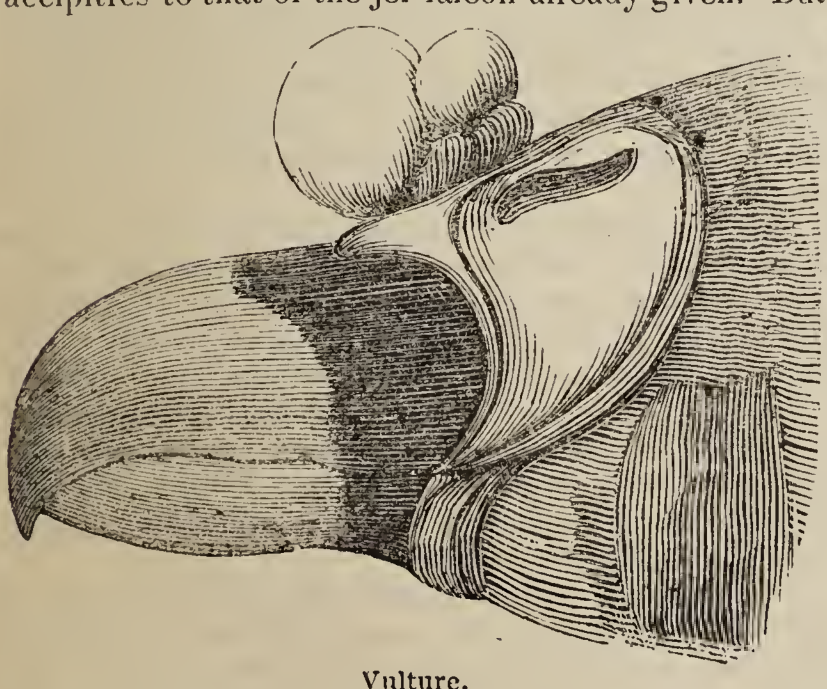
Through the low flighted hawks there is a gradual departure from the model of the jer falcon, till we come to the beak of the kite, which combines some of the characters of the falcons with some of those of the owls. And the feeding of the kite is of the same mixed character. It captures birds when it dares and can; but it does so chiefly on the ground, adds mice and reptiles to its mess; and although a bird of fine wing, and one of the most airy hoverers of the race, there is no dash or dignity about it.

In the eagles we have a further modification of the bill. It has no decided tooth in any of them, neither is it so strongly formed in proportion to its size as in the high-flying falcons, even in the most powerful of the race; and in the fishers, the outlines of the tomia are nearly even. New characters present themselves in this division of the order; they do not contend with their prey in the air and on the wing, and they feed more upon mammalia than the hawks, though they also make great havoc among the larger ground birds. We shall, however, be better able to understand those differences when we come to consider the feet and wings.

The beaks of the vultures are much feebler than those of any of the species already noticed. Instead of the arched outline, which, though it gets flattened in the others from the falcon downwards, is nearly an unbroken curve from the tip of the beak to the posterior part of the skull, the vultures have a depression at the base of the bill, and another in the middle in some of the species. The bill is also much longer and also wider in proportion to its height, and the cutting edges of the tomia are in all the species nearly, and in some of them completely plain; and it is without the sliding action at the points of the mandibles. Thus it can grasp a larger portion of substance than the beak of the falcon; but it can separate that only by simple pressure of the mandibles against each other; and, independently of its being without the sliding or tearing motions, the mandibles are neither so stiff for pressure nor moved by such powerful muscles as those of the other diurnal birds of prey.

From their mode of feeding, and the substances on which they feed, vultures do not gain from the velocity of the points of their long mandibles that which they lose in power from the diminished strength. In birds, and in animals generally which snap, the velocity makes up for the loss of power; and though the greyhound cannot hold fast like the bull-dog, his momentary bite is sharper. It is the same with many of the long-billed birds; but the vultures are gnawers and not snappers; and they are not so able to divide recent flesh as the other diurnal accipitres. Therefore, their chief food is carrion, or the bodies of animals which have become tender by the progress of putrefaction.

The annexed sketch of the beak of the vulture may be regarded as the opposite extreme in the diurnal accipitres to that of the jer falcon already given. But



Vulture.

the vultures do not lead by a natural gradation from the more typical diurnal preyers to the nocturnal ones. They point to another portion, or rather to two other portions of the class. In the forms of their bills they have some approximation both to certain species of the gallinaceous birds, and to certain tribes of that division of Cuvier's great order, Passeres, which, for want of a better name, we shall call omnivorous; and it is not a little remarkable that, like the gallinaceous birds, they have naked skin upon the head and neck, and that skin *blooms* in the season as in these.

The nocturnal birds of prey have the bill more slender than the day-feeders, generally much hooked from the base, compressed, sharp at the tips of both mandibles, smooth in the outlines of the tomia, and without tooth or notch. It takes up the connexion with the bills of the diurnal feeders rather from one of the characters of that of the kites, than from those of the vultures, which, in their general structure, may be considered as the lowest in the diurnal division; and this might be expected, as the nocturnal feeders—the owls—are not feeders on carrion, but in general kill their own game, chiefly mice, and other small mammalia, which have been mentioned as forming, in part, the food of the kites.

But, though such is the general food of the majority of the owls, and though they have the habit of wounding and disabling such prey by the snap of the bill, as well as by the clutch of the talons, there are some of the more powerful species which have different habits, and the bill differently formed, to agree with those habits. These are chiefly inhabitants of the north, and in certain states of the weather they come abroad in the dim twilight sort of day, which, at some seasons and in some states of the weather, obtains in those dreary and inhospitable climes. Mammalia are the general prey of those more powerful owls upon such occasions; but it is said that they also attack and despatch birds, especially when these are exhausted and overcome by the violence of the weather. They have been described as giving chace on the wing, but it has not been said that they kill prey in the air; and indeed, the muffled feathers and soft flight of owls do not fit them very well for such an office. They are popularly called "eagle owls;" and if there is any propriety in the name, they should kill their prey on the ground, though they may seek for and in so far follow it in the air.

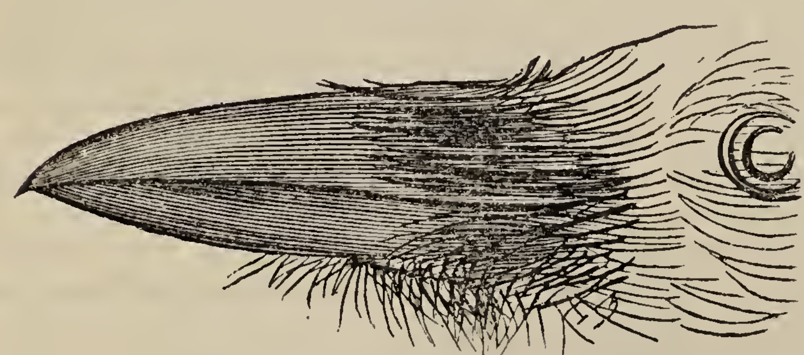
In proportion as the birds of this order depart from the type of the jer falcon, they seem to be incapable of depluming their prey, or depriving it of its indigestible covering, or taking the flesh from the bones. In proportion as they are thus incapacitated, they take the indigestible parts of the food into the stomach. But these do not pass the pylorus into the intestinal canal. They remain in the stomach till all the parts fit for the nourishment of the birds are separated, and then they are discharged by the mouth in sapless balls, called "castings," or quids. The species which have this habit cannot, of course, feed upon animals of any considerable size—not larger than they can swallow, because they cannot masticate; and though an owl can separate the viscera of its prey, it is not capable of disjointing the bones even of a mouse.

We have entered somewhat more into details respecting the bills of this order of birds than we shall be able to do with those of the remaining orders; but they are not only well marked in their structure and habits, they are also in no small degree the typical members from which a general notion of the class can be best formed.

Omnivorous bills.—In the order of Cuvier's classification, an outline of which has been given in a former section, the bills of the *dentirostres* should follow those of the birds of prey; but though these have generally a notch in the upper mandible, and often in the under one, none of them has the bill suited for tearing the recent flesh of warm-blooded animals, as in the falcons, and their claws are so formed as to be organs of motion and support, and not killing instruments. Their general habit, if birds which are so diversified in their appearances, powers, haunts, and manners, can be said to have a general habit, is that of feeding upon insects and their larvæ, in what may be called the "free state;" that is, when they are so situated as the birds have not to hawk for them on the wing, or to dig them out of the earth, the bark of trees, or other places of concealment.

The bills, in order to accord with that general habit, do not require the firm texture and powerful action of those of the accipitres. As many of them have to seize their prey quickly, as they often catch it while it is on the wing, though they do not fly after it, rapidity of motion, both in darting at the food, and in opening and shutting, with firmness and sharpness at the tip, are the requisites of such a bill; and lightness in its general structure is essential to the quick motion. Hence, these bills are, in very many of the species, so thin and weak that they are not able to break the coat of a vegetable seed between the edges of the tomia, and their owners are called *soft-billed* birds. If an arrangement were to be attempted from the bill, as adapted to a certain species of food, the insectivorous birds would have to be taken from several orders, because the feet and wings vary with the manner in which the birds get at their food.

The *omnivorous* bills, and even many of those of the birds that live much upon seeds,—the *conirostres* of Cuvier, have considerably more resemblance to those of birds of prey than the dentirostres. They vary much, as might be supposed in birds which inhabit so many places; but perhaps the most typical of the whole, and the one which takes up the connexions most closely and naturally from the vultures, is the bill of the raven, a resemblance to which may again be traced through many genera.



Raven.

This structure of bill is intermediate between those of the vultures which feed principally upon carrion, and the woodpeckers and analogous races which obtain their food (chiefly insects and larvæ) by digging or thrusting into cracks in the bark of trees, and fissures of rocks. It is inclining to straight, and can inflict a severe wound by thrusting; it is ridged and arched in the culmen, and firm in the tomia, so that it can cut by the pressure of the mandibles; it is a little hooked at the tip, and waved in the tomia, so that it can keep a firm hold, while the owner tugs and tears by the motions of the neck; and as it is long, the snap of the point is very sharp from the rapidity of the motion. It is, in short, a very serviceable bill—a bill of all work, as it were; and when properly examined, it is found to answer well with the omnivorous habit of the owner.

And the raven, though not very numerous in any place, and though dwelling in solitude, pairing for life, and not being very prolific (as is the case with most birds of prey), is one of the most generally distributed of birds. Almost every other species has some country which it can claim to a very considerable extent as its own; and even though it is migrant, and passes the different seasons in places some thousands of miles asunder, it returns with the season, not only to the same latitude, and to the same land, but often to the very same spot. The raven is no migrant, except in shifting a little with the seasons as the supply of food varies, but never quitting the same district; and yet there is no country in which the raven is not found native. The margin of the desert, of the jungle, or of the forest, in the hottest climates,—the heights of alternate cliff and copse in temperate climates, or the rocks and heaths, and even the lichen-clad margins of the inhabited earth near the poles, are all equally the abodes of the raven; and let the sun blaze, the wind blow, the rain pelt, or the snow drive, with ever so much intensity, his dusky wing or firmly set foot is in its element, and the wreck of the rest of nature is with him the season of plenty.

The raven is thus an exceedingly typical bird; and from the numerous and varied habits, and structures in accordance with those habits, which are combined in him, he is what may be called a sort of central type, in which the characters of many other races may be found, though rudimental, or at least partially concealing each other. Those characters are also chiefly combined in the bill of the raven; though in his feet he approaches the vultures, and in his wings partially the low-flying hawks.

In tracing the gradation from the raven through the analogous races, we find that the bill gets less and less powerful in those characters in which it most resembles those of the vultures, namely, its adaptation for tugging and tearing the flesh of animals from the bones. But the raven is also a preyer. He rarely, though sometimes, hawks on the wing, and when he does so, he strikes with the bill, not with the claws; but he preys much on the ground, on young birds, the smaller mammalia, and even the larger ones when disease or casualty brings them within his reach.

Of the others, the carrion crow most resembles the raven; but its bill is neither so formidable as an instrument of slaughter, nor so capable of tearing the flesh of recent prey. The culmen of the upper mandible is not so much arched, nor the tip so much hooked, and consequently the bill can neither cut so well nor hold so firmly. This bird accordingly eats large animals, chiefly in the state of carrion; and finds much of his food in the eggs and callow young of the ground gallinidæ.

The other crows, on to the rook, have the bill more and more approximating to straightness; and in that bird we have certainly an approximation to the ground birds which feed upon seeds; and different as they are in their appearance, and many of their habits, there is a correspondence in nature between the rook and the skylark, which brings them to the same field for their food.

The bill of the raven and crow, is continued through the magpies, the rollers, and several other birds, which differ more and more in the other parts of their structure and in their habits, till we come to those races which are more and more tree birds, and when they become chiefly so, have a considerable part of their character in the feet.

There is still another division that may be traced from the crow tribe, and the portion of the character of the bill which they carry along from the raven, is that of snapping with the mandibles. We find this rudimentally in the jackdaw, a little more developed in the chough, and so on till we come to those birds which catch insects upon the wing ; and here again we find a subdivision : one race having the toes united, and terminating in the bee-eaters, and other tribes with bills very long, sharp at the points, slightly arched, not very heavy, but beautifully formed for possessing the maximum of effective strength and ready motion. The other subdivision leads to the swallow tribe, in which the bill is not so much an instrument of death as of capture ; and they, as well as the former subdivision, are dependent on the air for the chief part of their food ; and, as might naturally be supposed, have their proper characteristic in the organs of flight.

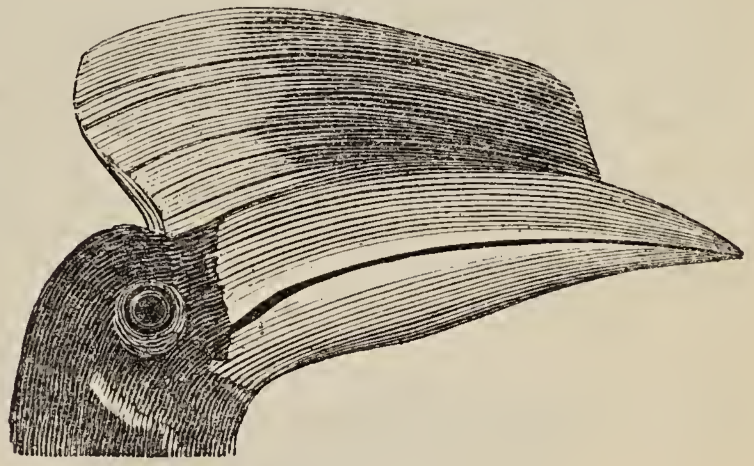
To trace out these connections with all that minuteness which they would require, in order to see clearly the resemblances and differences of birds, as depending on the nature of their food and their organisation for capturing it, would far exceed the limits to which this sketch is restricted. But the hints which have been thrown out may serve to call the attention of observant readers to this very instructive part of the subject ; and if such shall be the case, the object of what has been said will be, in a great measure, accomplished ; and that object, if we are to allow that the great business of human life, is pleasurable enjoyment—is one of far greater importance than those who have not reflected on it are aware of. Birds are always about us, in a state of nature, go almost where we will ; and the greater part of them, instead of seeking safety by escape from our view, as is the case with all those animals which cannot fly, and which are not too formidable or too repulsive to prejudice for our remaining to examine them, seek it by rising and spreading themselves out, as it were, for our examination in the free atmosphere. Hence, when we are abroad, be it for pleasure, for health, or for business (and the journeying time is, in so far as the last of these at least is concerned, so much time lost), the birds are an ever-open book, in which every one may read as he walks or rides ; and thus turn to a means of acquiring the most useful knowledge those hours which to them who have not this habit are not only utterly lost, but which are even painful in the passing.

There is in this last circumstance, and it is one the pain of which is felt by every one who is not absolutely seared to indifference, a most useful lesson. If we throw idly away those portions of time which we cannot employ in our ordinary business, they fail not in galling us for the neglect, and if we persevere in the idle habit till it ceases to be galling, the mind is thereby so unnerved and broken down that, if we do not seek ruinous escape in dissipation, we become unfit for those very avocations, our eagerness for success in which is the cause why we neglect that nature which should afford employment to our minds in the necessary pauses.

It is worthy of remark and remembrance that, in all those revivals in which nations have come back from a state of listlessness and decline to vigorous action and improvement, the study of natural history has always formed an early and a prominent part ; and that, in all the fallings-off, that study has been among the first to be neglected. As it is with nations, so it must be with individuals ; for the one is merely the sum of the other, and the sum can be nothing but equal to the individual parts of which it is made up, either in quality or in quantity. But to return to our more immediate subject.

Many of the foreign species of omnivorous birds differ greatly in their bills, as well as in their general appearance, from those which are met with in the British islands. The most remarkable of these are chiefly inhabitants of warm countries ; and the hornbills (*Buceros*) and birds of Paradise (*Paradisea*) may perhaps be regarded as the two extremes, at least in peculiarity of structure.

The following figure of the bill of one of the hornbills of India and the Oriental Isles, will give some notion of the form of this singular organ.



Hornbill.

The bills of the other species differ from that of this one chiefly in the form of the horny enlargement on the base of the upper mandible ; but as that is not developed, or at least does not attain its full size till the birds arrive at maturity, which takes three or four years ; and as it is not nearly as much developed in the females as in the males, it is subject to so many variations in the same species, that it can hardly be depended on as a character. From the figure it will be seen that the true bill of these birds has not the robust thrusting form of the bill of the raven, but more resembles that of the chough ; and notwithstanding its formidable outline it is feebler than even that.

The basal enlargement is cellular, and all parts of the bill are comparatively weak. The mandibles are also more or less notched or serrated along the whole of their cutting edges. This bill, if we except the horny enlargement, the use of which in the economy of the bird is not known, approaches to those of the toucans and other enlarged billed climbing birds of the tropical forests, only in these the upper mandible is much more enlarged, instead of having the enlargement in an appendage. Leaving the appendage out of consideration, the bills which those of these birds resemble most nearly are those of the aracari, only it will be seen on referring to the figure that the aracari has the better formed bill of the two.

Still, however, there is so much resemblance between them as to lead to a presumed correspondence in the habits of the birds, though their feet indicate a different haunt. Both genera eat carrion, eggs, insects, and occasionally vegetable substances; and both are rather indolent and lurking birds in their general habit. The toes of the aracari are yoked, so that it is a branch bird, inhabiting living trees, among which it jerks about something in the manner of the jay. The hornbills have the toes free, like the rest of the omnivorous birds; and though most of them can perch readily and firmly, they prefer perching on dead branches to those which are covered with foliage. When on the ground they do not walk, but hop as magpies do.

A bill of this form cannot be efficient against any very powerful animal, because its great size and length, and light structure, render it impossible to close the mandibles with much force, though the bill may snap at small objects with much less labour on the part of the bird than if it had been of stronger texture. These birds connect the omnivorous races pretty closely with the insect feeders; for though they all eat carrion when it can be procured, the various insects which breed in and consume rotten wood in the tropical forests appear to form the chief subsistence of those hornbills which are more exclusively forest birds; while those which feed more on the ground pick up ground beetles, which are also numerous in those localities. The serrated margins and snapping motion of those large but lightly formed bills are sufficient so to crush an insect as that it can be advantageously taken into the stomach; and when they have recourse to carrion they seem to be equally attracted by the putrefying animal matter, and the larvæ with which it is inhabited.

The other extreme, birds of Paradise and analogous genera, as may be seen by the figure, have bills smaller and firmer, and approximating more to those

Paradise Pie.

of the gallinidæ; and though they are understood to feed less exclusively on the ground than any species of that order, yet their food bears no inconsiderable resemblance; and it is not unworthy of remark, that the native localities of the more remarkable of the perching gallinidæ and the birds of Paradise border with each other in their native localities, as the peacock in India, the Argus pheasant in Sumatra and Java, and the birds of Paradise in the isles immediately to the south and east.

To explain, or even to enumerate, all the varieties in the bills of those omnivorous tribes, and the differences of food and haunt which those indicate, would be incompatible with the nature of a general sketch; but the subject once entered on, is one of very easy study; and there is scarcely any tribe, at least of land birds, traces of resemblance to which may not be found in one species or other of the omnivorous race. Still, however, there is a definite character in the bills of the whole, and that of the raven is not completely lost even in the hornbill or the bird of Paradise.

The whole race are also what is usually termed "foul feeders." Their voices are harsh, but, generally speaking, they are capable of being taught to articulate. They are also familiar birds, and not difficult to be tamed, partly, perhaps, from their indolent habits, and partly from their voracity. Generally speaking, they are prying and hopping creatures; and when they seize living prey, they jump at and stab, or snap it with the bill. Altogether, they are a serviceable race, and their labours tend much to preserve vegetation both in field and in forest in places where they are numerous.

Bills of the Conirostres.—These form the first natural division which we can trace from the omnivorous bill of the raven, upon that part of its compound character which relates to the action of the mandibles against each other by pressure in the simple division of hard substances. Bills of this description are without any notch or tooth; and they are always of firm texture, on which account the small birds that have them are often styled *hard-billed* birds, in contradistinction from the insect feeders, which have the bill with a tooth or notch, but of comparatively slender structure.

Birds having bills of this description vary much in their structure and habits; but generally speaking, they may be considered as more peculiarly birds of temperate and even cold climates. This is what might be expected. In tropical countries, the vegetation of trees may be said to be constant, and the ground vegetation is in a great measure propagated by bulbs, or, at all events, the seeds of herbaceous plants do not strew the ground there either so numerously, or for such a length of time, as they do in regions where the winter is more decided. There is thus not much food for, at least the ground species of the Conirostres, in tropical climates, and where they are found, they are not so migratory in their habits as the soft-billed birds. In such climates as that of England, their grand feeding time is in winter, because the fields are covered with seeds, which are softened and sweetened by the action of the weather, but have not begun to sprout; and perhaps there is no race of wild animals so serviceable to cultivation in such climates as these birds. They come in vast crowds, and clear the stubble field of the seeds of weeds, which, if they were to spring up, as of course they would do, if not gathered by the birds, would completely choke the crops in the following season.

The bills of all these birds are thick and strong, enlarged at the base, sharp at the tip, and the mandibles are often fortified by a margin, which, acting upon the tough rinds of seeds, bursts them, and extracts the farinaceous part, which is much more readily and effectually done by the flat grinding margins of the bill than it would be by sharp edges. The different effect of these two kinds of form in effecting this purpose may be perceived by any one who tries to crack a nut with a pair of scissors, and another with a pair of nut-crackers of the same lever-power.

The birds which have those bills do not feed exclusively, or at all times, upon seeds. Indeed, it will readily be understood, that at those very times when these birds stand most in need of food, that is, while they are preparing their nests and rearing their broods, the supply of seeds for them is very limited compared with what it is in winter. The groundsels, and various other wild plants, keep flowering and producing seeds with little interruption all the year round; but the supply from these, even where farming is conducted in the most slovenly manner, would not support the tenth of those flocks which feed on the fields in winter. Accordingly, though there are a few tribes which eat the seeds of those plants, these form but a small portion of the whole, and there are very few genera which are not, to some extent or other, animal in their feeding during the nesting time. It is worthy of observation, too, that at that season they disperse over the breadth of the country, so that more than the pair, or the family, when these grow up, are seldom seen together, or in anywise associated, even though the same species should collect in thousands during winter. This is a wise provision in nature; for the birds crowd to the fields at the very time when their presence there is most useful; and again, when their individual labours are more immediately required in reducing the numbers of insects and worms, they are distributed over the country.

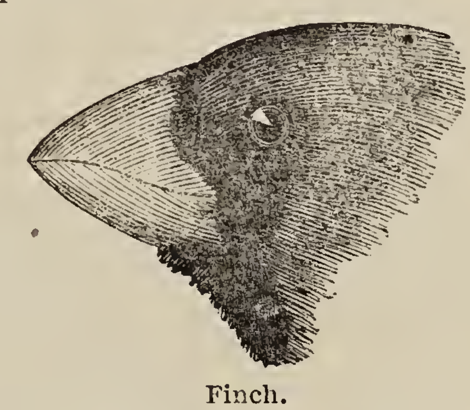
The bills of those birds are familiarly exemplified in that of the common house sparrow, which may be considered as about the average. As is the case in the birds of prey, the smallest bills in this order or division are often the most efficient. The tits are perhaps those which, among our native birds, connect the conirostres most immediately with the feeders on tree insects, or rather, perhaps, with the omnivorous tribes, and they are equally remarkable for the smallness and the efficiency of their bills. The bottle tit (*Parus longicaudatus*) has the bill so very short, that it barely appears beyond the produced feathers at the base; yet this minute bill is one of the most active, hardy, and efficient little instruments in the whole animal economy. It can bite sharply and hold firmly, and there are few birds which construct more elaborately beautiful nests. Though on a very small scale, the bill of this interesting little bird is a perfect model, the maximum of usefulness with the minimum of matter. The bills of the other species of the genus are all finely formed, though none of them are quite equal to this one.

The bills of this genus partake a little of the characters of those of some of Cuvier's *tenuirostres*, though they are capable of performing more severe labour than most of these. They do not break the hard crusts of seeds by squeezing them between the mandibles, but rather hew them asunder by strokes of the bill, and in the same way they dig into the folds of buds and the crevices of bark for the larvæ and the eggs of insects; nor have they any aversion to carrion when it comes in their way.

The bearded reed bird, which has generally been described as one of the genus *P. arus*, has the bill intermediate between those of that genus and the finches and linnets. It is stout in proportion to its size, but it is slightly curved in the upper mandible, and thus it is a bruising bill rather than a thrusting one. The habits of the bird correspond. It lives in reeds over the marshes, the seeds of which are not so hard in the coats as the seeds of plants on dry ground.

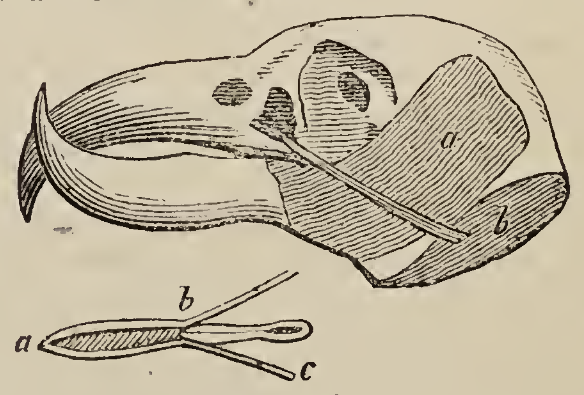
The larks may be regarded as more directly connecting the conical-billed birds with the insectivorous ones; and they have so many points of resemblance to the pipits, which are insectivorous, that these used to be included in the same genus. The buntings stand in nearly the same relation to the larks that the bearded reed bird does to the tits, one of them at least is a reed bird, and they are all more vegetable in their feeding than the larks.

The finches and linnets have the bill the most perfectly conical; and they are thus the most typical birds of the order. They are vegetable, or nearly so, in their feeding, at all seasons. Extending over a great range in latitude, and inhabiting places very different in their vegetation, from the dense forest to the bushless waste, they feed very indiscriminately on the seeds of trees and herbaceous plants, and often the thick tunics of wintering buds. Their bills are simply bruising bills, though they vary in form, size, and strength, according to the food of the birds. In general, however, the mandibles are of equal length, and very sharp at the tips. The following is the general type.



Finch.

The crossbills form a very curious exception to the bills of this order of birds, as will be seen in the following figure of the common crossbill (*Loxia curvirostra*), which is of the natural size, and taken from a dissection by Mr. Yarrel, to whom we are indebted for the original and the best account of this curious organ, and the mode of its action.



Crossbill.

Figure 1, is a profile of the bill, with the skull and the principal muscles. The one marked *a*, and situated in the posterior part of the skull, is articulated behind the centre of motion in the articulation of the jaw; and the one marked *b*, extends before it as far forward as the gape; but these are assisted by other muscles.

Figure 2 is an outline of the tongue, which is as curious as the other parts of this feeding apparatus.

It will be seen that both mandibles have a double curvature; the upper one is curved downwards and the lower one upwards, and the one curves to the right and the other to the left, so that the points cross each other; and Mr. Yarrel found them to be about three-eighths of an inch apart when the bill was closed at the basal part. In the figure the upper mandible curves to the right and the under one to the left; but that arrangement is reversed in many of the specimens. The side to which the mandibles turn is thus not a specific character of the bird.

The upper mandible is united to the frontal bone of the skull by plates of bone which are a little flexible, so that that mandible has a little lateral motion. This agrees with that very general law in the animal economy, in virtue of which every part which is subject to violent motion or pressure is always so formed as to give a little, by which means a sudden strain upon the moving part is not so forcibly propagated to the rest of the body; but beyond this limited motion, the base of the upper mandible is very strongly supported. The lower jaw, the sides of which are deep and strong, and the coronoid process near the middle of their length, is so much elevated as to give them all the stiffness of triangles, is articulated by concave sockets upon spherical processes on the *os quadratum*, and thus they admit of lateral and oblique as well as vertical motion in that mandible. The pterygoid processes of the upper jaw are very long, and the pterygoid muscles correspondingly large; and when the jaws are fully closed, that is, when the coronoid process on each side is brought into contact with the pterygoid on the same, the mandibles are crossed to the full extent. The muscles of that side of the head to which the lower mandible curves, are larger than those of the other side, so that their action has a tendency to draw the mandible toward that side; but as the closing muscles, which have their insertion before the centre of motion, pull the mandible to that side, the opening ones, which are inserted behind that centre, pull it to the other; and thus the parts come in contact when the bill is opened. The action of the bill thus resembles that of a wedge, by the mandibles sliding upon each other, and thrusting the points asunder at once with great force and great firmness.

Before stating how this bill is used, we must advert to the tongue, which is an important part of the whole organ. Fig. 2, on the cut is an outline of the upper side. A portion of the tip from *a* to *b* is in the form of a scoop, raised at the sides, and thin and rounded at the extremity. This scoop is composed of horn, supported by a particular bone, which is articulated to the os hyoides or common bone of the tongue *c c*, at the point *b*; and one set of muscles bind the joint at *b*, and thereby depress the point of the scoop, and draw it backwards; while another extend the joint, and project and elevate the scoop. The tongue has thus what may be called a sort of elbow joint, and the scoop performs the office of a sort of l and in picking up those substances to which access is procured by the oblique motion of the mandibles. The bill thus performs the functions of two bills; and one of them could not performed by a bill of any other construction.

The way in which the points of the mandibles move, draws them into any substance of which they can take hold. If that substance is of a texture not to be cut by the points, they split it open by their wedge-like action; and if it is a softer substance, they at the same time cut it in the cross direction. Whatever may be the depth of the opening, the eye also sees to the bottom of it, and the scoop of the tongue can reach it. The upper mandible is the part of the bill at rest, and therefore to whichever side it bends, the head is bent to the other, and the eye on it commands all the space, which the point of the under mandible pushes open, from the contact to the greatest extent in crossing.

Crossbills are found chiefly in the extensive pine forests of the northern latitudes, where they live upon the seeds of those trees. These seeds are contained under tough woody scales, which continue pretty close for some time after the seeds are ripe; and the chief labour of the bird is to raise these scales by the oblique motions of the bill, till the seeds can be scooped out by means of the tongue; and they do this, or even split a piece of dry wood into strips, with great rapidity. Sometimes, from causes not very well understood, as they are not regular migrants, they leave their native forests in considerable numbers, and do no small damage to orchards of apples by splitting the pulp in pieces to get at the pips.

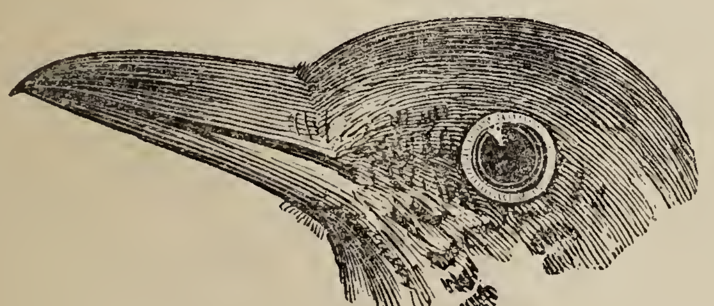
The strong muscles on the sides of the head give them something of the air of parrots; and though they are not climbers as these are, they resemble the parrot tribe a little in their plumage. One species (*Loxia pytiopsittacus*) is popularly termed the parrot crossbill. Indeed, though their habitations are in the opposite extremes of climate, and the parrots get at their food by climbing, and prepare it by cracking the rind or shell with the mandibles, while the crossbills get at theirs by flight, and raise the scales without separating the cone from the tree, yet the two families have many points of resemblance.

Insectivorous bills or *Dentirostres.* The insectivorous birds, when properly restricted, consist of those genera only which have the common normal feet with three toes before and one behind, all articulated on the same level, and thus have their more peculiar characters in the bills, or the bills and the wings. They are inhabitants of woods, copses, and bushes, those being the places where insects are most abundant, though some of them inhabit the margins of waters, and nestle in holes of rocks, or under stones. They all take their food either standing on the ground or perching on the sprays, or they dart upon it by short jerks from the ground or the perch. Their bills are accordingly all snapping bills, generally light in their structure, having the upper mandible rather longer than the under one, and notched near the tip, but not so sharp pointed or so firm in the tomia generally as the bills of vegetable feeders. The point of the bill is the prehensile part of it; and the culmen of the upper mandible is usually a little arched to support that part. In those genera which are characterised by superior boldness the bill is compressed, and the upper mandible hooked at the tip, while in the feebler ones it is rather depressed, and the tip straighter.

The shrikes, a figure of the bill of one of which is annexed, are the most daring birds of this division, and the ones which connect it most obviously with the predatory or omnivorous birds; but the resemblances are much slighter than those which can be traced between order and order in other parts of the system. The larger beetles form the principal food of the shrikes; and as many of those in the larvæ state, and some of them when perfect, are destructive to vegetation, shrikes are useful birds to the cultivator, while, as they do not eat vegetables, they do him no harm. The shrikes are, however, chiefly woodland or hedge birds, and leave the open fields for the pasture of rooks. They do not inhabit the very cold countries, as their staple food is not so abundant in these. Many of the beetles on which they feed have the elytra or wing-cases very hard, almost proof against the action of the bill, notwithstanding its strength and its notches. In these cases, the birds are understood to stick their prey upon thorns, and divide and eat it at their leisure by the strokes of the bill. It is also said that in this way they bait the hedges for the purpose of capturing the feebler insectivorous birds; but though they do sometimes kill birds by pinching their necks between the mandibles as they do beetles, these and some other habits which are attributed to them would require to be well authenticated. The bill of the shrikes can both strike and squeeze more powerfully than that of most of the division; but still it is properly an insectivorous bill.

Shrike.

The next gradation of this character of bill is in the thrush tribe, which have the middle and outer toes united, so as to form a firmer walking foot than that of the shrikes; and they are accordingly more of ground feeders. They partake more of the vegetable feeding character; inhabit colder climates, and live upon berries in the severe weather; but mollusca and worms form the principal part of their summer food. But whether animal or vegetable, these birds prefer soft food—mollusca to worms, and viscid pulpy berries to farinaceous ones or seeds. Their flesh is in consequence more sweet and juicy than that of many birds; and these qualities are increased by the small tendency they have to flight, unless when, as is the case with those that summer in the more inhospitable climates, they are obliged to migrate.



Missel Thrush.

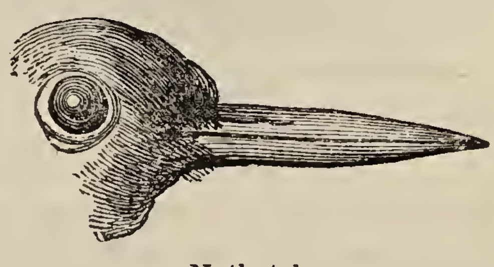
In accordance with these habits, the tomia of their bills are sharp cutting edges, as the hardest labour they have to perform in feeding is breaking the shells of snails, which they do by hewing them to pieces with the point of the bill. The preceding is the general figure of these bills.

The ant-catchers, dippers, menura, manakins, todies, fly-hunters, fly-catchers, and a number of other races, chiefly inhabiting the warmer parts of the world where insects are most abundant, follow these, varying in their bills with the nature of their principal food, and in their other organisations with their haunts and action; but all agreeing in the general structure of the bill as insectivorous, and generally having it of such consistency as that it can bruise or divide a hard crusted insect. The greater part of them also agree in residing where food is more permanently to be found, and consequently not being so much given to distant migration as many of the insectivorous races which remain yet to be noticed.

To these again succeed the chats, wagtails, chanters, warblers, and analogous genera, having the bill generally feebler, feeding on larvæ and soft insects, generally sweet singers, much affected by the vernal season, and migrating to warm climates in the winter. In them the notch in the bill is not quite so conspicuous; and in the wrens, especially the crested wrens, it approaches in some of its characters to the bills of the *Tenuirostres* of Cuvier; and in the pipits to that of the larks, though the insectivorous character is not lost even in them.

Common Wren. Robin.

Bills of the Tenuirostres. These are chiefly, though not all, insect feeders, and have their bills slender and without any notch at the tip; but they differ considerably in form with the places where the food is obtained, and in consistency with the nature of the food itself. They are bark birds, wall birds, or rock birds, yet some of them range the air for their food, and others seek it in the nectaries of flowers. The feet rather than the bill form their distinguishing character. The nuthatch, which is a



Nuthatch.

climber, has the bill straight, angular, and very strong, and it feeds much upon nuts, the shells of which it punches open with considerable activity. The tree creepers which also run on the boles of trees, and dig in the crevices of the bark for insects, have the bill of moderate length and angular, but a little curved. The wall creepers have it very long and slender, and angular only at the base. The nectar suckers have the bill weak and very slender at the tip, and the tongue extensile, tubular as a sucker, and cleft at the tip. The humming-birds have the bill in general long, and the tip of the tongue formed as a sucker; but the bill is in some of the species straight, and in others crooked. The hoopoe has the bill very long and slightly arched, and feeds on tadpoles and other produce of marshy grounds. But the bills of these birds are so unlike in their forms, and differ so much in the uses to which they are applied, that none of them can be taken as any thing approaching to an average of the whole; and indeed the character of the anisodactylic feet is not much more perfect, for in some, as in the nuthatch and creeper, it is a most efficient climbing foot, yet in others it resembles more the common foot of many of the insectivorous birds.

Bills of the Fissirostres. As all these birds use the bill, and the bill only, in the capture of their prey, and as they catch it on the wing, the bill affords a very good general character. They are all feeders upon insects, and generally capture them by speed of flight. They fly at smaller game, and capture it only with the bill; but they admit of a division into diurnal and nocturnal, something resembling that of the birds of prey. The diurnal ones are the swifts and swallows, the former the longest flighted of birds and the most unwearied on the wing. The latter soft and loose feathered, and rather clumsy in their flight, as is the case with the owls. This subdivision contains the goat-suckers and the *Podargi*, some species of which bear a resemblance to some of the owls, and have stronger bills than the rest of the family.

The bill in all of them is remarkable for the wideness of its gape, and the breadth of the mandibles at their bases; and it is sometimes provided with a viscid secretion to which the insects adhere, and at others with mustaches, in which they are caught, or at least prevented from escaping out of the mouth.

The bill of the common goat-sucker is probably the most typical of the whole, at least it is more exclusively used in preying; as the bird not only feeds in the twilight, but flies with the eyes in such a position as that they can be of little or no use.

Goat-sucker.

Bills of the Syndactyli.—The bills of the syndactylous birds also differ considerably in their forms, because the food differs in kind; and there is no doubt that it was on account of this difference of the food that Cuvier named this division after the structure of the feet, and not that of the bills, for the kind of food is the principal ground of his arrangement. But in the case of birds the kind of food is not so descriptive of the whole character as in the mammalia, because the form of the bill depends also upon the manner in which the food is arrived at.

In the birds which should properly belong to this division, the prey is arrived at on the wings, though Cuvier, from having taken the united toes as the general character, has included in it the hornbills, which, in some of the species at least, are as truly omnivorous as the crows, feeding on carrion, and of course feeding on the ground, not on the wing.

Leaving these out, there remain four genera, all of which have the bill long, and catch their prey by the snap, or quick compression of the mandibles against each other. The bee-eaters (*merops*) have the bill rather long, tapering to the point, slightly curved in its whole length, and sharp in the cutting edges. That of the motmots (*prionites*), which, in some respects, answer in America to the bee-eaters of the eastern continent, is much stouter, having a considerable resemblance to the bill of hornbills, though without the enlargement at the base of the upper mandible, by which the bills of that genus are distinguished. The bill of the motmot is serrated in both mandibles, and the tongue is barbed or feathered like that of the toucans. Indeed, it should seem that this genus, as well as the former, ought to be included among the omnivorous birds, notwithstanding the syndactylic feet; the feet of birds in this division come so little into play in those which really belong to it, that they are hardly of sufficient importance for being made the ground of classification. Besides, these birds kill other little birds, either by gnawing them between the serrated edges of the mandibles, or beating them against the ground. They are indeed chiefly ground birds, bad fliers, and though in great part living upon insects, they catch them upon the ground; and almost the only habits which they have in common with the typical birds of the order, are living solitary, and nestling in holes of the ground.

The kingfishers have the bill robust, quadrangular, and straight; and though it is a fishing spear rather than an insectivorous bill, it agrees with that of the bee-eaters in being used on the wing. The following figure of that of the common kingfisher of Europe will give some idea of its general form.

Kingfisher.

The remaining genera of this division, none of which are European birds, have the bill bearing a considerable resemblance to that of the kingfisher, which may be considered as the most characteristic bill.

Bills of the Scansores. These, the climbing, or *Zygodactylic* birds, have no general character in the bill which can be applied to the whole, though in the smaller grades into which the order may be divided, the bill is sufficiently characteristic of the food and manner of feeding.

The whole order are forest birds; and, with the exception of the woodpeckers, some of which inhabit the cold or the medium climates, they are all tropical birds, or birds of the warm countries; of those wild forests which have been sown by the hand of nature, and in which every tree is the very best adapted to the spot on which it grows. Every animal of these teeming climes is also produced under circumstances the most favourable to its development and subsistence; and the energies of life of all kinds, obeying that grand stimulus of material life, the sun, is in the very maximum of activity. Man is the only creature that languishes, or appears to be out of his element, not merely in his mental powers, but in his physical structure. This by the way is a proof, among many others, which the study of nature in all its varieties affords, of the existence of a spirit in man—an immaterial principle, and consequently one over which material death and dissolution have no power. For if he were wholly material, and obedient only to those physical laws to which the whole of material nature is subjected, he needs must be in the state of greatest development in those places where natural action is the most intense. It is no argument to allege that these ardent climates are not so well suited to the human constitution as those which are more temperate; for though this may be true of a native of Europe visiting those countries, it is not true of their native population. Nor can it be said that, physically, man is better adapted to the colder climates than to the warmer, but rather the reverse. Man has naturally no furry coat like the polar mammalia, nor downy feathers like the polar birds; and his only natural clothing is a sort of thatch to the head, as if more immediately to protect that portion of his fabric from the action of the vertical sun. Therefore, in as far as man can be said to be physically adapted to one climate more than another, the adaptation is to the warm rather than to the cold. But we find that the more energetic and valuable part of his character is less developed in those places where nature also is most energetic, and where he, if he were merely the produce of material nature, should, according to all the evidence that we have, be most energetic also.

But though here, as in all cases, man must be put aside as being *over* the system, not *of* it, the rest of the system in these beaming and blooming lands works vigorously and, at the same time, beautifully in concert. The birds may, in all countries, be regarded as the keys to natural history; because in consequence of their aerial nature, and their capacity of better accommodating themselves to such food as they may find when they are very hungry, they can so speedily adjust themselves to changes of season, that the adjustment is made before we are aware of the necessity for making it, as the bird is to us the harbinger of that very change in nature, of which its change of place or of action is the consequence.

There are no places to which the native birds are better keys than the tropical forests. The great majority of them—all this order, with the very few exceptions which have been noticed, are forest birds, either on the trees, or passing from tree to tree, or if they feed on the ground in the open places, not ranging on foot, as the ground birds of our latitudes do, but finding a full meal at the places where they alight.

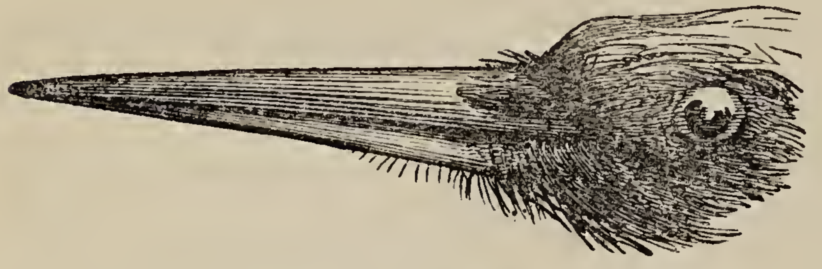
The vegetation of every region determines the character of all its living inhabitants, and though the birds, as the most sensitive to change, are the keys or indices, the vegetable tribes are the foundation of the whole, which support many of the animals immediately, and the rest indirectly through the medium of each other. There are few small farinaceous seeds in those forests; and the leaves of the trees are not so succulent and so well adapted for the food of insects as the deciduous leaves of the mean latitudes. Their average production is perhaps not so great as that of our forest trees, during the short period that they are in activity; but in all tropical countries the season of growth is double, and in many it is of more frequent occurrence, and where there is humidity enough the growth is constant. The leaves are required for shade; and as natural circumstances always produce that very organisation or structure which suits them best, the shading leaf is firm in its structure, and not liable to be gnawed and eaten like the more tender ones.

Woody substance is that which has the tendency to accumulate to excess in those forests; and, therefore, the great body of the insects there attack the wood of the trees. As these insects have much labour to perform in clearing the forests of their lumber, they exist in proportionate numbers, generally social, and in bands which no man can count. These crowd all parts of the trees, and indeed many of the spaces between them; but they are on the boles and branches, and in the decaying wood, rather than on the leaves. The winged ones, too, crowd over the trees and the flowers of those climbing plants, with which the boles are intwined and the branches interlaced. These are, however, more seasonal than the races which inhabit the trees, or rear themselves huts and towns on the ground; and therefore they do not form so large a portion of the food of the more typical scandent birds. The bee-eaters, the cuckoos, some resident and others migrant, and the warblers, and other soft-billed birds which are driven from the temperate climates as the winter sets in, are the chief consumers of this more temporary produce of the tropical forests.

The same absence of farinaceous seeds which prevents the number of ground-feeding birds from being so great in these places, also prevents the smaller seed-eating mammalia. The small mammalia there gnaw bark, and roots, and bulbs and fallen fruits. The number of insect eating reptiles is also very great. All these contribute to the food of the omnivorous races of those climbing birds; but though some of these eat eggs often and birds sometimes, the destruction of bird by bird is not so great in those forests as on the more bleak and barren portions of the earth. There is no scope there for the rush of a falcon, or the stoop of an eagle; and in the depths of the forest, the birds stand more in danger of preyers that commonly crawl, than in those which have wings or even feet. The snakes are the greatest enemies both of the birds and their eggs. Vultures are found in the openings of such forests, for places where there is so much production, and by consequence so much waste of life, require a great deal of scavengership; and where the forest "crops out," towards the mountain, there are also hawks and eagles; but in the depth of the shade, bird is in a great measure at peace with bird. Accordingly though there are some very curiously formed bills among them, there are none that can be considered as of a very murderous character, for the most formidable ones belong to those which feed on vegetable substances; and the owners are so completely tree birds that the bill is a climbing instrument, by the hooked upper mandible of which they can, if necessary, hang a considerable time without sustaining any injury.

The bills, though not admitting of typical example or description, as appropriate to the whole order, may yet be conveniently explained in groups.

The first group includes the bills of the jacamars, the woodpeckers, and the wrynecks. The bill in all these is straight, fitted for digging into the bark of trees, and extracting insects and larvæ; and though some of the birds are of considerable size, and the insects on which they feed remarkably small, yet they pick them up with wonderful celerity. The following figure will show the general character of the bill.



Green Woodpecker.

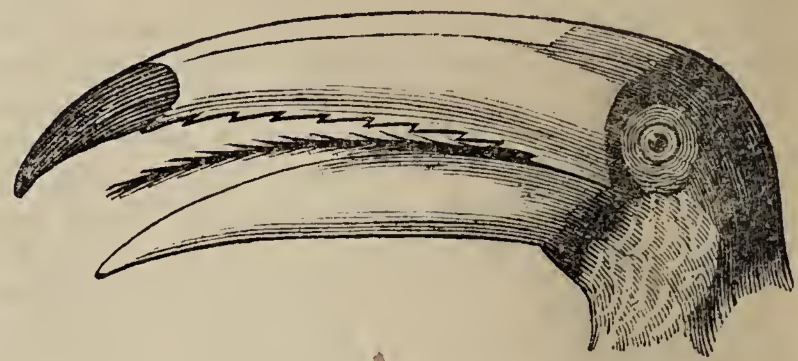
The woodpeckers have the stoutest bill and the best fitted for hewing into timber. The wrynecks as frequently pick up saw-flies and other small winged insects, which alight on the bark for the purpose of depositing their eggs; and the extent and freedom of motion in the neck are both very remarkable. The American jacamars, though they do not peck, have the bill resembling that of the common kingfisher; but their congeners of the East have it more slender, and a little arched, inclining to the form of that of the bee-eaters, and they are not so much in the habit of climbing as the others.

The cuckoos have the bill of moderate length, but differing in form and structure in the different genera of which the group is made up, as these differ considerably in their feeding and other habits. They do not dig in the bark for insects; and they inhabit the copses and open forests rather than those which are deep and tangled.

Between the cuckoos and the toucans there occur several genera with bills very much diversified in shape, and with the owners of course as miscellaneous in their feeding. In general, however, they are insectivorous, or add to these small earth animals, and sometimes the mere succulent vegetable substances. The keel-bill is named from the strong projecting ridge or keel on the culmen of the upper mandible, as one of the best known and most remarkable of these, remarkable alike for the universality of its agreement with its own species, and with all other creatures, excepting those that serve it for food, and for the miscellaneous nature of its feeding. It alights on the backs of domestic animals, and clears their coats of insects.

Of all this order, however, and indeed of all birds, with the exception perhaps of the hornbills, this instrument is most singularly formed in the toucans. There are two genera; toucans proper (*Rhamphastos*), and aracari (*Pteroglossus*), of which the systematic names are not very descriptive, as each has the character expressed by both. Each is *rhamphastos*, large bill, or, colloquially, "beaky;" and each is *pteroglossus*, winged-tongue, or feather-tongue; but the toucans have the bill largest, always exceeding the section of the head, and sometimes as large as the whole body, while the bill of the aracari is not thicker than the head. The following sketch will show the general form of the bill of the toucan.

The general substance of this vast bill is cellular, with the partitions of the cells so very thin that, large as it is, it is very light. In the living state the covering membrane is very finely coloured with prismatic reflections, but these soon fade after death. The rudely serrated edges are a little firmer than the other parts, but still they could not injure any but a very soft animal.



Toucan.

The tongue is stiff and cartilaginous toward the point, and for some distance pectinated on each side with stiff cartilaginous fibres, which give it something the appearance of a feather.

From its structure we may readily conclude that a bill of this description can be little more than a prehensile instrument, unfit for breaking a hard substance, or cutting a tough one. It seems, indeed, to be a sort of mortar, in which soft substances are in so far pounded by the action of the curious tongue, as that they can be swallowed. Insects, probably the naked and the more tender shelled mollusca, and the eggs and callow young of little birds, are the food of these birds; in search of which they hop about the trees, and though their wings are rather short, they fly tolerably well. The two genera are not very different in their food, or in their other habits; but besides the difference in the size of the bills, there is a remarkable difference in colour, which runs through all the species. The prevailing character of the true toucans is black, relieved with brighter tints on the throat, breast, and rump; that of the aracari is generally green, relieved on the same parts with red or yellow.

Though they belong to different orders as well as to different parts of the world, there are some resemblances between the hornbills and the toucans; and the one family of birds perform in the one continent nearly the same office which the others perform in the other. We have a similar instance, with something approaching to the same difference of character, in the *merops* of the eastern continent, and the *prionites* of the western. Indeed, in all cases in which the birds, or other animals of tropical America and the tropical parts of Asia and Africa can come into comparison, we find that those of the former part of the world indicate forests more close and tangled but less abundant in fruits than those of the latter.

Of all the climbing or zygodactylic birds, the parrot tribe, in their several divisions of maccaws, parrots, paroquets, and cockatoos, are the most typical, the most exclusively inhabitants of trees, and the least frequently found upon the ground. The species are very numerous, and the individuals are, in such places as are very favourable to their habits, in incredible flocks. They are all vegetable chiefly in their feeding, but some subsist more on the kernels of those forest trees which have hard membranous or shelly coverings, and others subsist on the pulp of fruits, rejecting the kernels or pips. But whatever may be the nature of their food, there is a general character of the bill which runs through the whole tribe; and, though those which feed more upon pulpy fruits have the bill more enlarged in its cross dimensions than the others, yet the figure of one bill is a very good index to the whole—better than in any other tribe of birds at once so numerous and so varied.

This tribe are more peculiarly characteristic of the tropical forests than any other of the feathered races; because, though they are often found flying over the open places between clump and clump of the forests, and shifting from place to place as they exhaust the supply of food, they are more in the trees, and, feeling the perfection of their climbing powers, are less apt to take wing on being observed, than any race which inhabits the same places. They are constantly in motion, except when they seek their repose, which is usually in the islets of rivers, or other places which are not easily accessible, and they resort there in numbers; and when they are in motion they are abundantly clamorous. Their natural voices are harsh, but they are easily taught to whistle, to articulate, and to imitate very varied sounds.

It is not owing to the form of the bill or the tongue that parrots or any other birds articulate, because their organ of voice is at the lower or pulmonary end of the windpipe, and not at the larynx or upper end. But their powers of articulation are sometimes really wonderful: the coincidences between the questions put to them and the answers which they return, must in all cases be regarded as purely accidental; and they claim their appearance of understanding, just as the predictions of pretended seers do their supposed knowledge of the future, from the fact that the ninety nine cases in which there is no coincidence are forgotten, while the one case out of the hundred in which the answer agrees with the question is remembered and repeated.

The disposition which these birds have to imitate sounds, not only different from their own hoarse cries in their native forests, but from any which they can hear there, are, however, indications of a very curious instinct, but of one which, as is the case with all instincts, it is vain to hope for an explanation upon the principles of reason.

The leading uses of the parrot's bill are, breaking hard vegetable substances, and climbing. A pair of nutcrackers is the nearest comparison to it in artificial instruments, but the bill is beyond all comparison the more universal and effective. This bill does not snap or acquire any force of momentum before it comes in contact with the substance to be acted on. It works wholly by pressure; but the pressure is accompanied by a sliding motion, which differs with the degree of exertion. The lower mandible is raised by very powerful muscles, and it is at the same time pushed a little forwards; the upper mandible has much less motion than the lower, but still it has more than in most birds; and when the bill is exerted with great force, it has a motion downwards and backwards at the same time. The substance acted on is thus wrenched round at the same time that it is pressed by the cutting edges of the mandibles; and every one who has attended to the subject, knows how very much a cutting operation is strengthened by accompanying it with a wrenching one.

The muscles which move the mandibles are very powerful, and give that peculiar fulness which appears in all the cheeks of the tribe; and the motion of the upper mandible, limited as it is in space, brings the whole of them into action. It is these compound motions of the working parts of animals, which enable them to act with so much less exertion than our mechanical contrivances; and taking time and effect both into the estimate, there is no tool by means of which the shell of a hard nut could be broken, without the expending of far more than double the power which is expended by a parrot. The tongue is of considerable use in guiding the substance to the most effective part of the mandibles; and even the motions of the neck are of service in breaking detached substances, as well as in detaching fast ones.

Very hard substances are broken between the point of the under mandible and the hook of the upper one, the lower side of which is slightly hollowed and roughened like a mill-stone by means of angular furrows, with their apices directed towards the tip.

The bills of the falcon, the crossbill, and the parrot, may be reckoned the three most powerful bills in the action of the mandibles that occur in the whole class, and as their action is wholly structural, not deriving any assistance from momentum, they may be reckoned the three most perfect species of mechanism—the first, for tearing; the second, for wrenching open; and the third, for breaking and bruising; and all of them are so formed as to have compound motions.

There are several tolerably distinct forms of bill in this very numerous and abundant family. The parroquets, which fly much from branch to branch in search of their food, have the bill smaller than the others, not exceeding one-third the length of the head, and not very broad; but it is very firm in its texture, and perhaps proportionably the most powerful of any. The parrots, properly so called, which are the most scandent, have it half the length of the head, and very thick and strong. The cockatoos, which inhabit more marshy places, and live upon softer food than the others, have the bill feebler. The maccaws, which use the wing more than any of the others, and find much of their food on the tops of forest trees, have the bill large, as long as the head, and very sharp. When birds feed wholly or partially on the wing, the bill is generally larger in proportion as the food is smaller. The ground parrots, which are better walkers than the rest, have the bill large, but the food appears to be, in part at least, taken by the tongue,

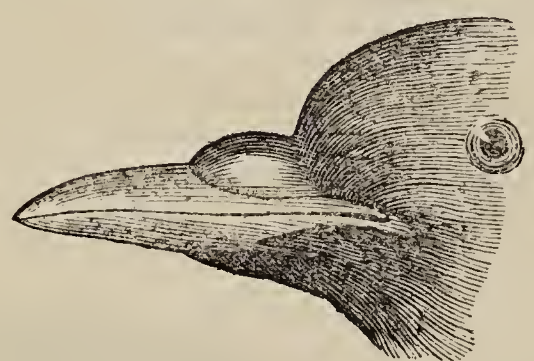
Cockatoo.

which is more slender than that of the others, but capable of being protruded, and armed at the tip with a horny portion cleft in two. The above figure will show the general form of the bill.

Bills of the Columbadæ.—We have already mentioned some of the reasons why the dove or pigeon family should be separated from the poultry; but as they are chiefly ground feeders, and as some of both perch on trees, and others sit or squat on the ground or on rocks, we may expect some correspondence in the form of their bills. The pigeons are, however, more vegetable in their feeding; and though they are by no means elaborate nest-builders, some of them at least do much more in that way than the gallinaceous birds.

There are three forms of bill among the pigeons, each corresponding to a difference of habit; but they differ so little from the bill of the common pigeon, and that is so well known, that we need not describe them at length, or illustrate them by examples. They are all simple feeding bills.

The tree pigeons, which are chiefly inhabitants of the warmer parts of the eastern hemisphere, and live upon the seeds of trees, which they gather on the trees themselves, and migrate from region to region after their food, have the bill strong, considerably arched, compressed and very sharp at the tip. In some it bears a resemblance to the bills of the smaller hawks, only it has no tooth, but in its use it approaches more nearly to the bills of the parroquets. The common pigeons have the bill more slender than the tree ones, and flexible for some part of its length, and they have their characters the more decided the more exclusively that they are found on the ground. The long-legged pigeons of the oriental isles, which are large and heavy birds, and more exclusively confined to the ground than any of the others, have the bill still more slender in proportion to their size; and in some of their habits, as well as some of their characters (such as having naked skin on the head), they resemble the gallinidæ. Both agree in having the nostrils pierced in a membrane at the base of the bill, and protected only by a cartilaginous scale, and not by hairs or feathers.



Pigeon.

Bills of the gallinaceous birds. The gallinaceous birds are all ground feeders, though they vary a little in the nature of their food, and the places where they find it. The whole of the tribe have the head very small in proportion to the size of the body, and the neck so long that the point of the bill can not only reach the ground, but command a considerable extent of it when the body is in a horizontal position. The bill is, in most of the genera rather short, arched in the upper mandible, and strong and hard at the tip. Indeed the bill of the common fowl, of which it is unnecessary to give either description or figure, is a very good average type of what may be termed a pecking bill. The two genera which have the bill different are the peacock pheasant (*Polyplectron chinquis*) of the east of Asia, and the genus *Tinamus* of South America, where they are called partridges or quails. Both of these have the bill straight, and longer and more slender than in the rest of the order; and in the American genus it is depressed, but has the upper mandible strengthened by a keel or ridge on the exterior. In their food, manner of feeding, and habits generally, they do not differ much from the rest of the order.

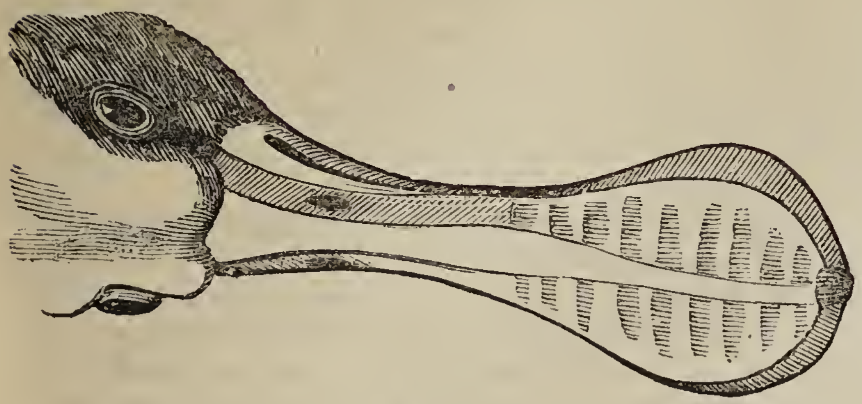
Bills of the short-winged birds. These have the bill very similar to the gallinidæ, which might be expected from the correspondence of their habits in feeding. The bustards, which, though not bad fliers, form the most natural transition from the one order to the other, have the bill strong, conical, or little compressed, and a little arched in the upper mandible. It bears a very considerable resemblance to the bills of those small birds which pick seeds from the stems of herbaceous plants.

The birds which are incapable of flight have the bills a little different. In the ostrich it is of moderate length, depressed, or flattened at the tip, having the mandibles of nearly equal size, and somewhat flexible, with a sort of nail at the tip of the upper one, but the tips are obtuse or rounded. It bears a slight resemblance to the bills of geese. This is the first indication of a grazing bill which occurs in the class, viewed in the order in which we have considered it; and the habit of the bird corresponds. The nhandeu, or ostrich of South America, has the bill shorter, and rather compressed toward the tip, which, however, is obtuse and furnished with a nail like that of the African ostrich. The cassowary of the south-east of Asia, has the bill compressed in its whole length, with a horny knob at the base, and a keel on the upper mandible which makes it stiff; but the lower mandible is flexible. These feed more on fruits and seeds than the others. The emu of Australia has the bill very similar to that of the South American ostrich.

The most singular bill of this order is that of the apteryx. The bird is altogether a singular combination; the body of an ostrich, the feet of a fowl, and a bill more like that of the ibis than any other. See Apteryx.

Bills of the Pressirostres.—These birds all seek their food on the ground, though not in the same places. It consists of worms, and other small ground animals, which are sought for in all places, from the dry waste to below the stones on the margin of the water. The bill is in general slender, and not very long; it is sometimes compressed, sometimes depressed, sometimes stiff, and sometimes flexible, so that it does not admit of general description, farther than that it is adapted for picking up small animal substances from surfaces bare of vegetation.

Bills of the Cultrirostres.—These birds have the bill, in general, very large and powerful, generally pointed at the tip, sharp, and sometimes toothed or serrated in the cutting edges. But though, in all the genera which Cuvier has included in the tribe, the bill is very robust; it differs so much in form and size, as hardly to admit of an average description. Thus the agamis, which are chiefly vegetable in their feeding, have the bill short and conical, not very unlike that of the poultry; the herons and bitterns, the first of which are fishers, and the others rather miscellaneous in their feeding, have it straight, or nearly so; while that of the spoonbills, as may be seen by the following figure, has very little of the knife-shape, from which the group is named.



Spoonbill.

The cranes, storks, and several other genera, all of which act the part of scavengers, and most of them are migrant, have the most typical bills. Among these are the adjutant of India, and the boatbill of tropical America. The latter bill is a very singular one. It resembles two boats applied the one to the other, and while the greater length of the tomia is trenchant, as in the storks, the tip of the upper mandible is hooked, with a tooth on each side, and that of the lower is pointed. It is understood to feed indiscriminately on fresh water crustacea, on reptiles, and on fishes.

There are, however, so many forms of bills among the birds of this very curious division, that no one can be selected as typical of the others, and the whole are by much too numerous to have a place in this short sketch. These diversities in the form of the bill show that, how much soever the birds which are arranged in this division may resemble each other in their haunts, the nature of their food, or their habits, the bill is not the part of their organisation after which they should be classed, though, in proportion as this part of their structure is less fitted for being the character of the group, it is better for distinguishing the genera.

Bills of the Longirostres.—The bills of this group, like those of the preceding one, do not admit of an exact average definition, farther than that they are all of considerable length, and generally less firm in their texture than most of the bills that have been noticed. But though they have no general form, they have a sort of general character. The birds which possess them are all feeders upon animal substances, which they seek upon the ground, generally in humid places, and some of them in the water; or if any of them eat vegetable matter, it is only that which is comparatively succulent, such as the bulbous roots of aquatic plants, or seeds which have been macerated in the water till they become soft. Many of them are flexible, consisting of a cellular bony substance, containing blood-vessels, and covered by a sentient membrane. They are a sort of intermediate between the bills of the land birds and those of ducks, and, as distinguished from the dabbling bills of the last of these, they may be called groping bills.

Some of them inhabit warm countries, and follow the lines of those rivers which are subject to periodical overflowing, picking up as their food the water reptiles, and other small animals, which are either driven from their retreats in the banks as the water rises, or left stranded when it subsides. The most remarkable of these are the genus *Ibis*, which have the bill very long, and bent from the base. In them it is harder than in most of the group, and not covered by a sentient membrane, but the mandibles are weak and flattened, so that, in arranging the birds according to their bills, these cannot be included among the cultrirostres, though, in their general habits, and also in the places which they most frequent, they resemble these more than they do the average of the present group. The more formidable prey, which they cannot so easily master with the bill, they dash forcibly against the ground, or stamp it to death with the foot.

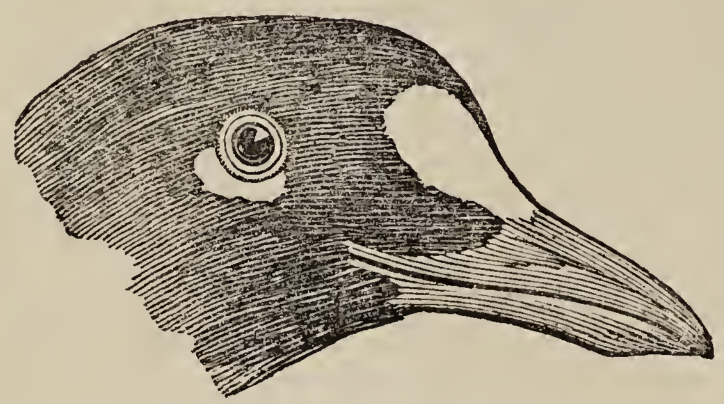
The majority of the group inhabit countries which are not liable to be parched by the sun, or they resort to such countries in the hot season; for, though many of them seek their food chiefly upon sandy or gravelly surfaces, they all seek it near the waters; and in the winter season they either resort to the shores of the sea, or migrate to climates nearer the equator.

Many of them seek their food by boring into the ooze and sludge, and in proportion as they have this habit more, their bills are longer, straighter, and more soft, flexible, and sentient. They are chiefly night or twilight feeders, because the ground animals of marshy and humid places come abroad then, but retreat and are still during the day. The time of their feeding thus renders the sentient bill of more avail to them than a hard one would be. During summer, when food is plentiful, and vegetation rank on the marshy grounds, one may traverse these the whole day without seeing a bird, or even hearing a note or a rustle; but as night sets in, they make the wilds alive with whistling and screaming. The bills of snipes and woodcocks may be considered as typical of this portion of the group. The avocets, which have the most singular bills of the whole, are more of day feeders than the rest. They feed by scooping in the runs of water, not by boring.

Avocet.

Bills of the Long-toed Birds.—These are also feeders on the margins of the waters, and the length of their toes affords them a firm base on slippery ground or upon tall herbage, among which chiefly they seek their food. Those which are less aquatic in their habits have the bill short, compressed, arched on the upper mandible, and sharp at the tip, having some resemblance to that of the gallinaceous birds; and those which are the most aquatic have it depressed, and produced on the forehead in a horny plate. Intermediate between these, there are others which have the bill longer, more slender, and enlarged toward the tip, as in the plover. The most striking character of these birds is the length and narrowness of their body, in consequence of which they can glide through the herbage with great ease and rapidity. The feathers of most of them are waterproof, and though the toes are never united by membrane at their bases, they are more or less margined for swimming. The bill of the coot is one of the most aquatic; and it bears some slight resemblance to the bills of the gulls.

There are two or three other genera of birds which frequent the margins of the waters, and live on food similar to that of the large-toed ones. The form of their bills would thus connect them with these ; but as they seek their food in places bare of herbage, find it less abundantly in any one spot, and must therefore range more on the wing in quest of it, all the other parts of their structure are so different that the connexion is not a natural one. These genera are, the flamingos, which resemble the herons in their haunts and many of their characters, but they live on mollusca and reptiles rather than on fish ; the pratincoles, which subsist chiefly upon insects which they capture on the wing; and they in some of their habits resemble the bee-eaters, and the carrion bird of Australia, *Chionis necrophaga* of New Holland, which has no type among European birds.



Coot.

The bills of which some account has been given, bring us to the margin of the water, and we have only to notice the birds which find their food in that element. The general characters of these depend less upon the bill than those of the land birds, but there are two well marked divisions : those which find their food at the bottom of shallow waters, and those which feed chiefly upon what is buoyant in the clear water,—though the first eat floating substances when they come in their way.

The first comprises the geese, swans, and ducks, which are all really ground feeders, only some of them feed almost exclusively on ground covered with water, and their bill and neck vary according to the depth of water with which their feeding ground is covered. As they are unable in all cases to see their food, they have the bill with a covering more or less sentient. They have the mandibles broad and flat, though often with an enlargement at the base of the upper one.

The gradation is from the geese, which feed fully more on the humid meadows than in the water, to the swans and swimming ducks, which never plunge the body, to the diving ducks which go to the bottom in considerable depths ; and thence it passes to the habitual divers which capture their food in the water, not at the bottom, and thus have the bill of a different form. As this gradation proceeds, the birds become more and more animal in their feeding.

Geese, which feed chiefly upon vegetable substances, have the bill elevated at the base, narrowed and rounded at the tip, comparatively short and stout, furnished with a nail at the point of the upper mandible of harder texture than the rest of the bill, and often of a different colour. The sides of the bill, which come in contact for a considerable breadth, are fringed with cartilaginous protuberances resembling teeth. This form of bill cuts grass something in the same way as the ruminant mammalia, which have the anterior part of the one jaw with cartilaginous ridges in place of teeth.

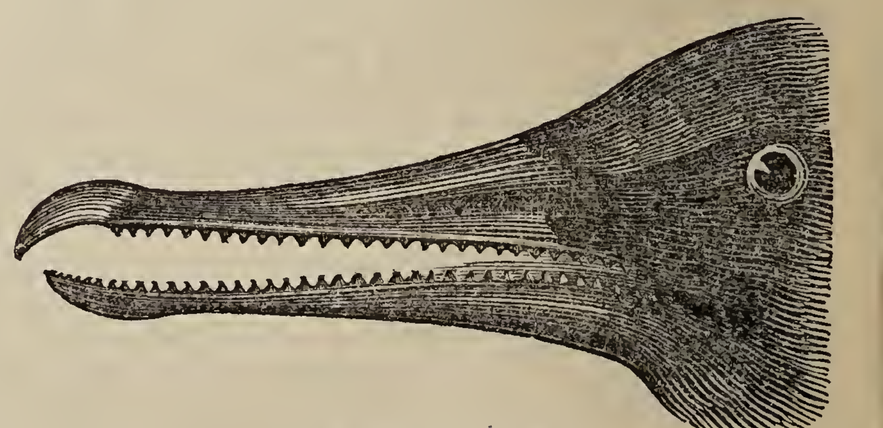
Swans, which are also chiefly vegetable in their feeding, but which feed more upon the roots of plants under water, have the upper mandible enlarged at the base, but the bill is larger than in the geese, of equal breadth throughout its length, and not so firm and robust.

Swimming ducks, which are omnivorous, but prefer animal substances picked up on the land or dabbled for in the water, vary a good deal in their habits, and their bills correspond. The common duck, which may be taken as the average, has the bill most flattened, and of the softest texture. These ducks have the neck lengthened, and plunge the anterior part of the body in the water till the axis is nearly perpendicular ; but they do not get so deep as to have the joints of the tarsi immersed.

The diving ducks have the neck and bill shorter than the swimming ones ; but still they feed not in the volume of the water, but at the bottom, and upon mollusca, worms, spawn, and other soft substances, and rarely if ever upon fish. This is the chief reason why their flesh is much more juicy and finer flavoured than that of the true aquatic feeders.

But there is a gradation in the diving ducks, the pochards, who resort more to the fresh waters, and the rich mud banks on the estuaries of rivers, have the bill much broader and flatter than the gannets, which may be reckoned the most seaward of all the duck tribe ; and there is a considerable trace of the fishy flavour in the flesh of the latter.

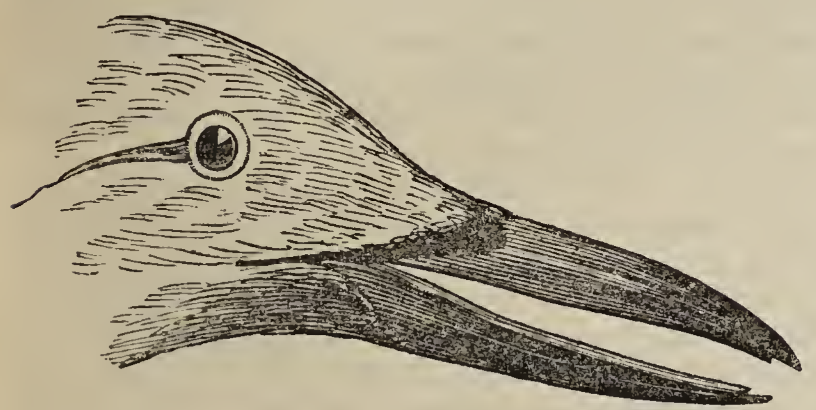
The mergansers combine the characters of the diving ducks and the true divers ; they catch their prey in the water, and not at the bottom ; but they are not formed for following it like the divers. They therefore require to have the bill of a more prehensile form than the one, and better able to retain its hold than the other. Accordingly, they have the bill lengthened, firm in its texture, nearly cylindrical, hooked at the tips of both mandibles, and serrated with reflected teeth along the cutting edges. They live upon fish and reptiles, and their flesh is rather rank in flavour. The following is a sketch of the bill of the red-breasted merganser.



Mergus serratus.

The divers and guillimots drive through the water with great rapidity, and transfix their prey with the sharp points of the mandibles, or wound it with the snap of the tomia, which in some of the species are furnished with a notch. This notch, which is of a very peculiar form, quite different from that in the bills of the rapacious or the insectivorous birds, is well shown in the bill of the foolish guillimot (*Uria troile,*) of which a figure is annexed.

In proportion as those birds which are dependent on the sea for their subsistence, and capable of following their prey to some distance under water, become less capable of motion on land or on the wing, their bills increase in power. We have examples of this in the razor-bill and the puffin, which though they can fly, do not habitually perform that operation; and still more in the great auk and the penguins, which have very powerful trenchant bills. With these one set of the sea birds may be said to terminate; and they bear nearly the same relation to the water that the ostrich and apteryx bear to the land—it is their principal, and almost their exclusive element.



Guillimot.

In the rapid sketch which we have taken of them, we have traced the birds in their regular gradation, from those that feed on foot upon the land, to those that feed by swimming and diving in the water. But the birds bring us out to sea on another element—the air; and there are tribes which take up the connexion from the heron and the kingfisher, which fish in the fresh waters only, and the succession continues till we come to races which are as discursive over the sea as the swallows and swifts are over the land.

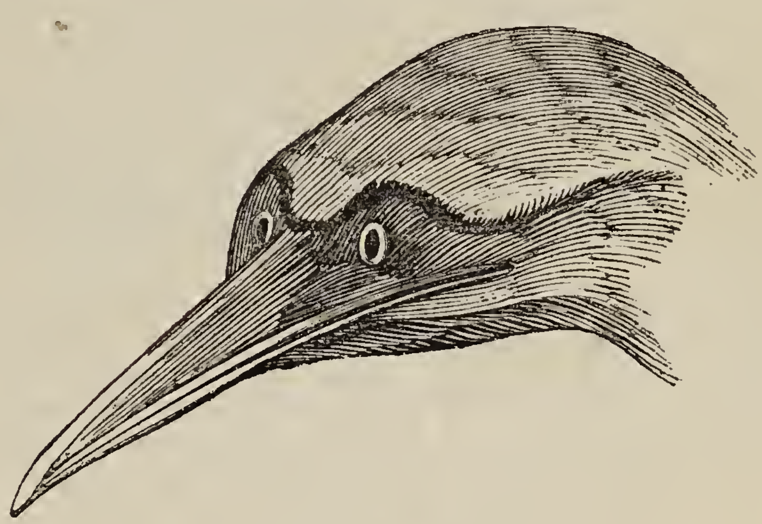
But as all these nestle on the shores (for there is no bird that breeds in the water), and as none of them can be insect feeders on the wing over the sea, there being no insects there, there is not the same diversity of habit among them as there is among the air-feeding birds of the land. The living produce of the shoreward parts of the sea, the waste and refuse which the sea casts up, and the waste which floats on its surface, are the three principal classes of the food of marine birds.

There are none of these birds which prey directly upon other birds, as the accipitres do upon land; and therefore there are none of them which have crooked talons or beaks like these. It is true that several of the eagles fish, and, though none of them refuse land prey when they can obtain it, there are some which depend more on the sea than on the land; but they are land birds, clutching their prey with the feet, and altogether unfit for swimming. Some of the sea-birds also prowl along the shores, and eat the eggs and the unfledged young of other birds: and there are some which rob others of the prey they have taken, by making them disgorge it from their stomachs; these last are birds of strong bill and powerful wing, but still their characters, though different from those of all land-birds, resemble those of the omnivora more than the accipitres.

The birds which make the most natural transition from the herons and other tribes which fish in the fresh water, are those which Cuvier calls *totipalms*, or entire-footed, from their having all the toes included in one web. These, though not the birds to which the name of "sea-eagles" is usually given, are the ones which in their habit much resemble the eagles; they dash into the water, and seize that prey which they have previously discovered by the eye, only they seize it with the bill. But most, if not all of them have a double habit; as they also catch prey while swimming on the surface; but they live more upon live fish, and less upon the offal of the sea than most of the other races.

The bill of the gannet, of which a figure is given, may be considered as the most characteristic of these bills.

It will be seen that it is stout at the base, nearly straight, has both mandibles serrated, and both tips a very little bent. Its outline is that which gives the greatest stiffness with the same quantity of materials; but the upper mandible, as in all bills which act very powerfully, has a little motion. When the bird descends with velocity, this bill transfixes like a spear,



Gannet.

and retains its hold like a barbed hook. The darter and the tropical bird have their bills formed in a manner similar to that of the gannet, and they also dart or descend on their prey; but the darter is a more landward bird, perching on trees, and fishing chiefly in the fresh waters, or in those salt lagunes where there are mangroves; and the tropical bird is more discursive over the sea.

The cormorants, which fly lower, have the bill less capable of thrusting with the point, or of resisting a strain on the base. Its thickness is more uniform, and the upper mandible is much more hooked, while the lower one is truncated, and a small portion of the bill has an oblique cutting motion. There is a trace of the carrion bill in it, and the mandibles are not serrated. The birds which have this bill do not fish in the same style as the gannets and darters. The bill of the albatross, which is a very wide-ranging bird, has still more of the carrion shape; but it has also a sort of tooth on the bend of the mandible, and thus can lift prey out of the water.

The true scavenger's bill on the "high seas" is that of the petrels, of which the fulmar's is typical.

The angular portion at the tip of the upper mandible of this bill, and the bend on the lower, which acts against it, are both very strong and hard, so that it is well-adapted for tearing the flesh of whales and of the larger fishes when their carcasses float dead on the sea. By that most efficient part of the bill being carried at an oblique angle to the water, while the bird swims or skims the surface, it can easily pick up all manner of garbage, however minutely divided, and even sip the oil which floats on the sea.

The numbers of these petrels are immense, far greater than those of any other birds—a single flock is sometimes seen as numerous as would cover the surface of a county. They afford a very striking instance of the vast productiveness of the sea; for they, numerous as they are, are only one of the races that subsist on its refuse. But when we consider that the sea is more than twice as extensive in surface as the land, and that it is inhabited to the depth of many fathoms, while the land can (as the barren places compensate for the elevations, whether of hills or of vegetables) be reckoned only as the one surface, we are within the limits when we say that the productive power of the sea is a thousand times greater than that of the land; or that, if its productions could be arrived at, and their nature would suit, the sea might support all the life that *could* exist upon the land, and never feel the burden.

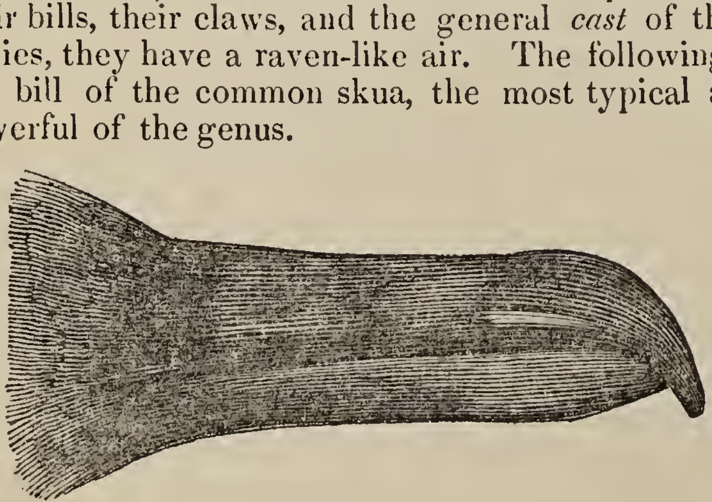
The storm-petrels are lighter birds, and of more rapid wing than the common petrels; but they have the bill of the same form, though weaker. They subsist chiefly upon the smaller garbage, and especially upon oil, which they collect from the water on the feathers of their breast, and then remove with the bill. All the petrels have the nostrils enclosed in separate tubes—sometimes single, and sometimes double; but the use of these in their economy is not known.

With the storm-petrels one group of sea-birds, classed according to their habits in feeding, and the structure of their feeding organ, may be said to terminate; but there is still another, the commencement of which may again be taken from the shore, and traced to the more extended pastures of the other.

The group which has now been mentioned as extending from the gannet to the storm-petrel inclusive, may be regarded as having a relation (such a loose relation of mere analogy as can exist between preyers at sea and preyers on land) to the birds of prey—the gannets and races which have similar habits to the eagles, the petrels to the vultures, and the storm-petrels to the birds which catch insects on the wing. The analogy is, as has been said, a loose one; but it is of use in forming a relative estimate of the economy of the sea and the land.

We may, therefore, continue it with the remaining sea-birds, which are principally the *lestri* or skuas, the gulls, and the terns. These are the omnivorous birds of the ocean; but the term, as applicable to that element, does not include vegetable food, though many of these sea-birds feed on land during the breeding season, and also when the sea becomes too stormy for them.

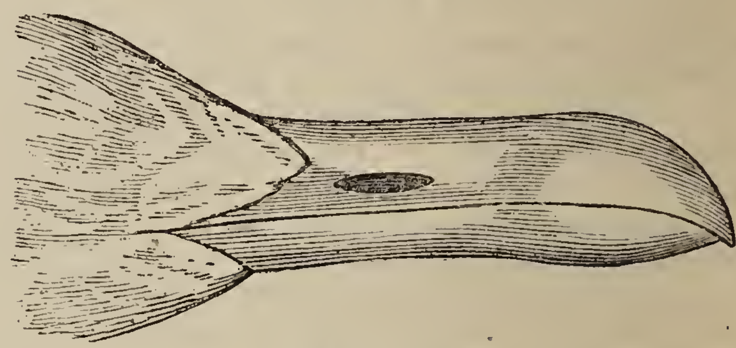
The *lestri*, though called eagles (the real sea-eagles are land-birds), are the ravens of the deep; and in their bills, their claws, and the general *cast* of their bodies, they have a raven-like air. The following is the bill of the common skua, the most typical and powerful of the genus.



Common Skua.

This bill is very strong, coulter-shaped, hard in its texture, and considerably hooked at the tip of the upper mandible, though nearly straight for the greater part of its length. But it is not a murderous bill or a very prehensile one. It has no tooth or notch, or even the sliding motion at the point which characterises gnawing bills. Accordingly, though the skuas are strong and bold birds, they do not kill full-grown prey, neither are they very dexterous in catching their own fish. They rob the nests of other birds, and they rob the gulls of the contents of their stomachs. They are, what their systematic name expresses, *lestri*—robbers, takers of that which belongs to others. They seek not the shore-bird, they seek its eggs; they seek not the sea-bird, they seek its food; and even among mankind, it has always been reckoned more cowardly to attack the infants than the father, and baser to injure "the means" than openly attack the man.

The gulls follow, as the rooks and crows of the sea, fishing occasionally, but only for fry and the smaller fishes, and living on carrion, mollusca, worms, and "whatever they can find." Some of them come occasionally on shore and clear the ploughed land of larvæ and worms along with the rooks; and not a few breed in small lakes and marshes many miles inland, and find marsh food for themselves and their broods. Their bills correspond, as may be seen in the following figure.



Common Gull.

The terns take up the succession from the gulls; and, in the gull-billed tern, which may be considered as the commencement, there is much similarity not only in that organ but in the general air of the body; and as we trace them to the more typical terns, the bill does not assimilate to that of the swallows (though the terns have—not very discerningly—been called "sea-swallows"), but to that of the pratincole, which may perhaps be considered as the last of the omnivorous feeders among the land-birds, and the most powerful on the wing. And it is not a little remarkable, that when this rare but beautiful stranger makes a dash over from the Danube to the Hebrides or Zetland, by way of a morning trip, it is found in the company of gulls and *terns*.

The storm-petrels are the real swallows of the sea—the birds which feed upon the lightest and highest production of the waters, just as the swallows and swifts are the last of the land tribes which feed exclusively upon living creatures; and, although the food is different, and requires a different form of bill, it is not a little remarkable that the general structure, air, and even colour of the storm-petrels, resemble those of the swallow tribe; while those of the terns have more of the pratincole in them.

Notwithstanding the length to which this part of the subject has already extended, there are still some very striking analogies of which it may be desirable to take notice, the more especially that they have not, so far as we are aware, been previously noticed by any naturalist who has treated of the feathered tribes, and also because we cannot with propriety introduce them into the particular account of any one group or genus. They are briefly as follows :—

In the first place, the flat-billed birds, which find their food at the bottom of the waters, have a very striking analogy to the ground-birds that feed upon land. Their flesh resembles the flesh of the grazing mammalia, the more exclusively that they are vegetable in their feeding, as in the case of the goose. The ducks, which are omnivorous, have more the flavour of poultry; and those which feed chiefly upon mollusca, ground worms, and the spawn of fishes, partake of the racy flavour of the land "gut-birds." As they become more and more feeders upon fish, they acquire more and more of the rank flavour ; and the auks and other species which scarcely fly at all, abound very much in oil.

It is not a little singular that it is in the two corresponding divisions of the sea and land birds, where we meet with the species which are confined to one element, and lose the grand characteristic of birds, the wings, though they retain the general structure and habits. The feathery covering is never wanting; but in the extreme of ground birds upon land it has much of the loose character of fur, while in the extreme of the divers at sea, it is so close and compact, that it has the appearance of one unbroken covering, in which the individual feathers cannot be distinguished.

In the second place, those sea-birds, from the marsh-breeding-gulls, or rather from the skuas, to the terns, which bear a resemblance to the *omnivora* among land-birds, are all, like these, good walkers, quite as much at home upon the shores as they are in the water or on the wing. This coincidence is the more worthy of being borne in mind, that the omnivorous birds are the only land ones which have the two motions of walking and flying nearly equal throughout the group ; and the corresponding group of sea birds are the only ones which possess all the three in equal perfection.

Those birds which are the most general in their feeding, are thus, also, the best fitted for reaching their food in all sorts of places ; and not only this, but they are the most generally distributed over the globe, and resemble each other the most in all latitudes. They are not the most numerous at particular spots, though many of them assemble in great numbers at their breeding places.

Between the air-feeding birds of the sea and the land, there is not the same perfect correspondence, because there are among sea-birds no literal preyers on the wing. There cannot be, for there is no food for them, as the sea sends up into the air nothing upon which a bird can subsist. The level of the waters is the upper level of sea-food, unless in that portion of the food of those birds which is cast up by the waves. But still there is a correspondence : they keep more to their own element, and have their motion more fitted for that, and less for the other two. Those sea-birds which seem never to tire on the wing, are all imperfect walkers ; and though they float very buoyantly, much more so indeed than those which are habitually on the water, they are by no means so expert at swimming.

The most perfect flight and the most expert action in the water are indeed incompatible with each other. Birds which float about the livelong day require to be light for their bulk and extent of feathers, though a heavier bird succeeds better on a momentary rush ; and the air birds which fly over the sea in search of their food do not require the same rapid motion as birds which fly in the air in pursuit of their food. But a bird which is to have the most perfect command of itself in the water, and be able to dive, and come up, and drive along, sometimes wholly immersed, and sometimes not, must, in order to perform its various evolutions with as little muscular exertion as possible, be of nearly the same specific gravity as sea water.

It is absurd to say, as has sometimes been said, that if birds have not a certain specific gravity they cannot dive. The lightest substance, the lightest gas, can be forced under water by mechanical means, and it is rather too much for us to suppose that we can beat nature with our small second-hand mechanics. But still it accords with general principles that that which is the most nearly of the same specific gravity as water, should admit of motion in all directions in water with the least effort. This principle is traceable in aquatic birds; for we find that the diving ducks ride deeper in the water than the swimming ducks, and the divers still deeper than they.

Then there is the difference of form. The motions which a diving bird performs in the water are so varied that to determine the solid of least resistance with regard to them all would be no easy matter. But the boat which rows fastest, keeps course or turns most easily, and lives in the roughest water, is an approximation. That boat is one with the two ends nearly equal, and of an average length. If too short it " yaws like a tub," and will not keep course, and if too long it turns wide. This is the form which we find in those birds which have the most complete command of the water. If they go on long courses after fish, as is the case with the divers, they have the body elongated ; and if they search about among the rocks after mollusca and crustacea, as is the case with the puffin, they have it shorter. These last, by the way, have the most powerful bruising bills of any of the sea birds, just as the parrots have among the land ones ; and it is curious to notice that there is a considerable resemblance both in the appearance and in the harsh screaming voice, so much so that the puffin is sometimes called the sea-parrot.

The boat shape of those birds, and the backward position of the feet, with the weight of muscles necessary for moving them, are incompatible with that structure which answers best for powerful flight. That, in order to be performed with the least effort, requires the weight to be concentrated near the centre of motion in the wings.

From these few observations, short and imperfect as they are, it will perhaps be seen that there might be a much more natural arrangement of birds founded upon their *principal habit* than any which can be founded on a particular part of their organisation. Air birds, ground birds, and those intermediate races which have the double motion in the case of land birds, and the triple one in the case of sea birds, might form the leading divisions.

An air bird is one which uses the wing in immediately obtaining its food ; thus an eagle which stoops to ground prey, a falcon which captures in the air but eats on the ground, a gannet which plunges in the water, and a swift or other insect feeder which feeds on the wing without stopping, are all equally air birds, arriving at their food by the action of the wings in that medium. So also a bird which immediately finds its food with the wings closed, or only with a partial use of them, subordinate to that of the feet, as in the birds which chase their prey under water, those that perch upon flexible stems and twigs, and a few others, is a ground bird. No matter whether it walks the bare earth, the vegetable surface, the boles or branches of trees, or perches, or climbs, or swims, or dives, if aerial motion does not form part of the act of capture, it is not an air bird. Many ground birds range far on the wing in search of places where they may feed or nestle; but the distinction between that and feeding on the wing, that is, arriving directly at the prey from the air only, is obvious enough. If the bird moves anew from any support but that of the air, that element has, as it were, rendered it up; and be the support rock, earth, plant, or water, there is an unbroken connexion with the ground.

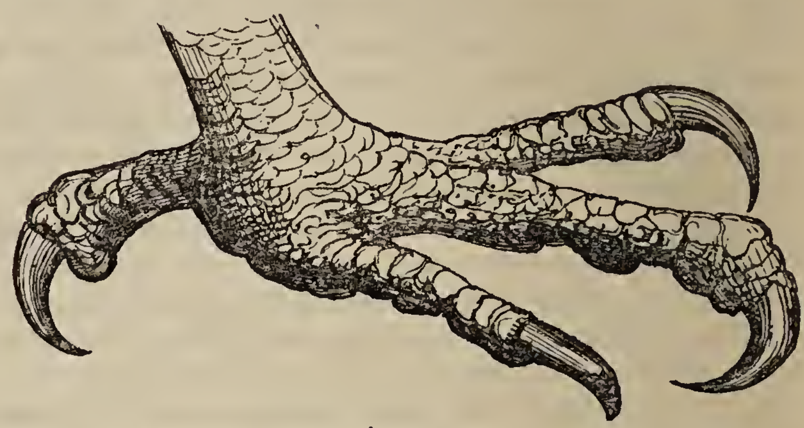
The distinction between omnivorous birds and either of these divisions is not so clear. But this is what might be expected: the air and the ground are the extremes, and in comparing them we have the advantage of the greatest contrast of which the class admits. There are some birds which have both habits, and they are chiefly miscellaneous feeders; and, if we had only two divisions, there are very many species which would belong equally to both; to the observer of the one habit they would be air birds, but they would be ground birds to the observer of the other habit.

With the three divisions there would still be difficulties on the confines, nor could we avoid similar difficulties though we made three hundred divisions; for in nature there are no absolute divisions but those of species, or perhaps individuals. Natural divisions are, therefore, out of the question in this or in any other department of natural history. But there is a natural gradation, and that gradation we can approximate, and approximate the more nearly the better that we understand the whole; but completely to reach it would require a degree of knowledge which man in this world never can possess.

The primary divisions in the arrangement which has been hinted at would be as unnatural, as artificial as those in any of the systems. But there would be at least one great advantage, we should have the whole bird presented to us in the general definition, and not a mere bill, foot, or wing, as we have at present. Thus we could, from a sort of general enunciation, proceed equally to all the parts by analysis, whereas, as matters stand at present, we have to collect the knowledge of all the parts, in perfect ignorance of the use which we are to make of this knowledge, till we are in possession of the whole. This is a very discouraging mode of going to work; and if we are compelled to stop short of the whole, all the labour which we have taken is without purpose and without profit; the subject remains unknown, and the mind has not profited by the exertion. But we must stop here; some further observations will be found in the article CLASSIFICATION.

VI. FEET OF BIRDS. From the notice which has been taken of the habits of the more remarkable birds in the preceding observations on the structures and uses of their bills, we shall be enabled to reduce this and the following branch of the subject to little more than mere catalogues; and all parts of the subject would have the same brevity, if a system could be formed as above suggested, free from all structural details; because then we would have nothing to consider along with any organ but its own immediate function.

The feet of birds are used in the air, on the earth, on vegetable supports, and in the water. The only feet which are, strictly speaking, used in the air, are used in the capture of prey, or they are *clutching feet*, the feet of all birds of prey, diurnal and nocturnal, but the feet of no other birds. The typical foot of these is the foot of the jer falcon.



Jer Falcon.

The character of this foot is to have four toes, all free to their bases, and three turned to the front and one to the rear, in the general habit; but those species which fish have the exterior front one reversible, so that the toes act two against two, and thus lift the prey more easily out of the water than if they had the common position. When the toe is reversible it is generally the largest in the foot, and the claws upon these feet have their under sides smooth and rounded as well as the upper ones; whereas those birds which use the feet only in killing, have the under sides of the claws grooved, or with two cutting edges, by which means they inflict much more lacerated and mortal wounds.

The claws of the more typical birds of prey (which are the only ones which get the name of talons) are used only in killing the prey, or in holding it while depluming, skinning, or tearing asunder, by the beak; but the vultures and other less typical species which eat carrion, and rarely kill living prey, use the claws more for retaining their hold, while they stand on the bodies of dead animals.

Size is not so much an indication of power in these feet as compactness and symmetry; the tarsi of the more powerful ones are all short; and in proportion as the preying of the bird becomes what is called more ignoble, the tarsi increase in length. Thus in the secretary falcon (*Serpentarius*) of Africa, which feeds much upon reptiles, and often upon poisonous ones, the tarsi are as long as those of the wading birds. This, however, is not to answer a wading purpose, but to raise the body of the bird above the reach of the envenomed prey, as this falcon (which, by the way, is not a falcon) kills by the clutch or truss of the talons, after the general habit of the order.

As walking is not much a habit with birds having this description of foot, the femur, or thigh bone, has not a great deal of motion or of muscle. The largest muscles are those which work the toes and claws, and they are situated upon the *tibiæ*. They are always protected by a thick feathery covering, and in the species which inhabit cold countries, the feathers are continued on the tarsi, or they hang down and shelter those parts of the feet, so that the tendons and ligaments may not be stiffened and rendered unfit for action by the cold.

There is considerable freedom of motion laterally in the toes of these clutching feet. When they are employed in violent or excited action, the four claws are nearly equi-distant, and all their points are directed toward the same centre, so that in whichever direction the prey writhes, it always runs itself more and more upon the point of a portion of the claws, and the trenchant edges at the same time tear and mangle its flesh. The same position of the toes enables the birds to perch on the points of rocks and other places of observation, from which they can discover their prey. But such feet are not well adapted for walking; and when the birds have to change their place even for a short distance upon the ground, they always raise or move the wings. Thus, though the foot of birds of prey is used for various purposes upon the ground, it cannot be regarded as a foot well adapted for any kind of progressive motion. The feet of ravens, and several other omnivorous birds, partake a little of this character, and hence they hop rather than walk, and partially raise the wings to balance themselves.

Ground Feet. Birds have so many different actions upon the ground, and the ground itself offers so many different kinds of surface, that it is not very easy to reduce the feet to any thing like an explicit system. If the bird is a swift runner, the tarsi are long, the thigh bones articulated a little farther forward, and their action more free; but then the termination of the foot, which is usually attended to in the descriptions of the feet of birds, varies with the ground on which it is to be used, and this again causes a modification of the other parts of the leg. If the back toe is long, and articulated at the same level with the other toes, then the foot must be placed farther forward, in order that the axis of the body may be carried horizontal, than when the hind toe is weak, or wanting, or articulated higher on the tarsus than the other toes. Feet also combine other actions, such as scraping in the earth, or swimming with their action of progressive motion upon land, and this farther embarrasses us in our attempts to classify them; so that, without writing almost as many volumes as there are kinds of feet, little else can be done than simply to mention the description of surface and motion, and notice the form of the foot.

For swift motion over arid surfaces, covered with dry sand, the foot of the ostrich is best adapted.

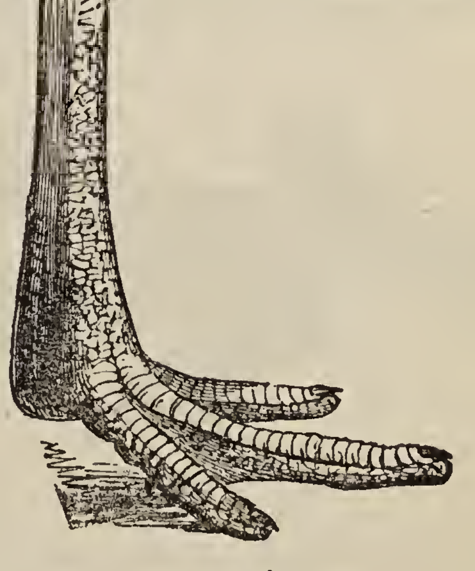
Ostrich.

This foot has only two toes, both thick and strong, the inner short, and without any claw; the outer longer, and furnished with a broad blunt one. The tarsus is very thick as well as long, and the muscles on the tibia are large, and extend as far down as the tarsal joint. The joints have little lateral motion, but the progressive motion is extensive, and the foot is lifted clean and high above the ground. As the ostrich is the swiftest of all running birds, we must conclude that this is the best running foot upon dry surfaces; but it cannot be considered as the normal foot of the group, for the others have three toes, and the cassowary has a long nail on the inner one, and the tarsi feathered a great way down.

The swift-footed birds which frequent the dry shores and heaths, but which have occasionally to pass over surfaces more or less humid or soft, have three toes before, and none behind in some species, a mere rudiment in others, but not a very large toe in any. They have the middle, or outer toe, more or less united by membrane at the base, according as the surface on which they generally run is more or less soft. They are all birds of flight, not having the muscles concentrated on the hind legs, like the ostriches, and their legs are in general slender; and though many of them run fast, the tonat take comparatively as long strides as the ostrich tribe. The foot of the common plover is nearly an average example.

Plover.

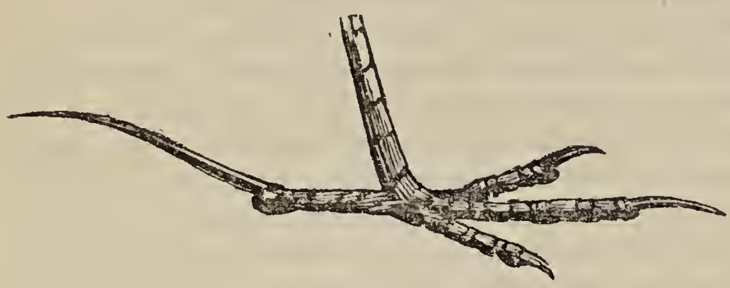
The bustards form a sort of connecting link between the "stilt" birds, which run upon dry and naked places, and the gallinidæ, which frequent richer and softer ground. They can fly, and flight is their means of escape from serious danger, and also of transport on their longer journeys; but in ordinary they walk or run. The following is the form of the foot, three toes before, with short membranes at the bases, and a sort of cartilaginous heel, but no back toe.



Bustard.

Birds which frequent very soft surfaces, have generally the toes larger, and bordered more or less with membrane; but unless there is another action besides walking to be performed, the difference of structure in the feet is not, in the case of winged birds, very great, whether they walk on the earth, or wade in shallow water over surfaces of the same kind.

Feet for walking on grassy surfaces. These have the three front toes free to their bases, and the hind toe articulated on the same level. The claws long, the hind one especially, but not much bent. These feet extend over a large base, and the elasticity of the grass assists the bird in jerking upwards till it can take wing. The foot of the skylark is an instance.

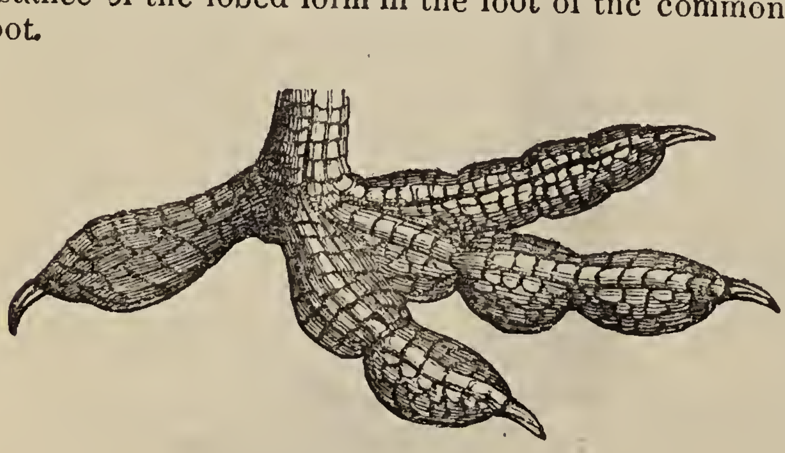


Sky-lark.

Feet for walking upon aquatic plants have the toes very long, and the birds which have them can generally swim. The common gallinule, or water-hen, is an instance of this form of foot.

Gallinule.

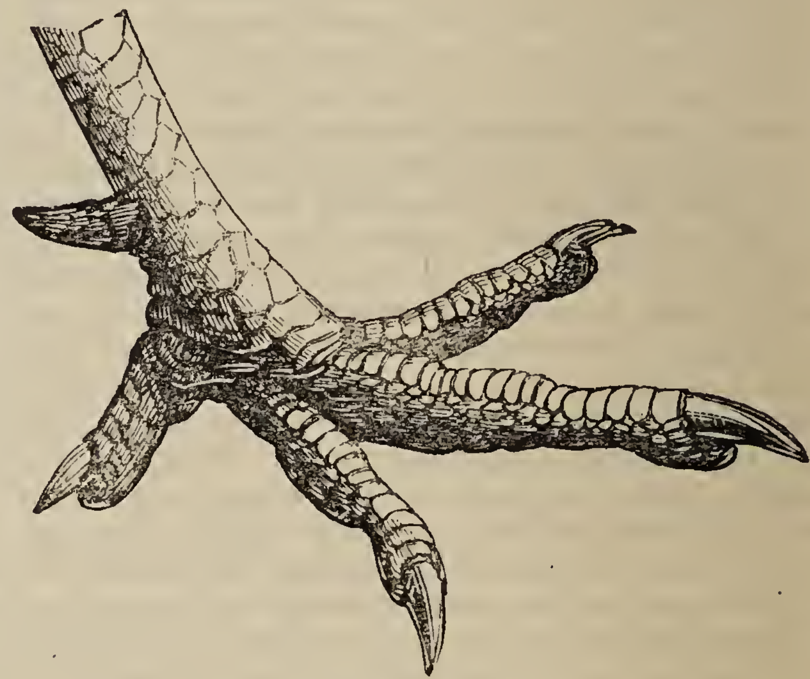
Some of the foreign birds of the same group (*Macrodactyli*) have the toes much longer in proportion. The length of the toes enables these birds to walk tolerably well, though the legs are articulated so far back as to give them the position of those of a swimming bird; and while all the species inhabit closer to the water than any other birds which have not the feet webbed, some of them have the toes lobed, and are excellent swimmers, though even these are most partial to those places of ponds and lakes in which there are aquatic plants. There is an instance of the lobed form in the foot of the common coot.



Common Coot.

Walking and scraping feet. These are more peculiarly the feet of the gallinaceous birds, all of which walk slowly on the ground, or standing on that reach the seeds of herbaceous plants, when they feed in a state of nature. They also scrape the ground with their feet, not only to lay bare seeds, worms, insects, and other substances upon which they feed, but to detach the small pebbles which they swallow to assist the gizzard in the process of digestion. The nails to adapt them for this operation, are rather broad and concave on their under sides.

These feet are all of the same general form, three toes before, and one behind, the front ones generally united by short membranes at their bases. The partridges have the membrane extending as far as the first articulation from the base, and in one South American genus, the hoazin, which is more aquatic than the others, the connecting membrane of the toes is altogether wanting. Some have the toes with tuberculated margins, and others have them smooth; but it does not appear that there is any particular difference of habit, for the smooth and rough toed ones indiscriminately perch or "roost" during the night, though they generally nestle on the ground. Those which roost have the feet stouter and the toes longer than those which squat on the ground; but those which squat are the swiftest runners. In general, however, their walk is slow, and in some it is stately. They always walk or run, and never hop, or raise both feet from the ground at once, unless when they are alarmed; and then, if they do not get fairly on the wing, they flutter, and lose command of themselves. The foot of the common domestic fowl is an average instance.



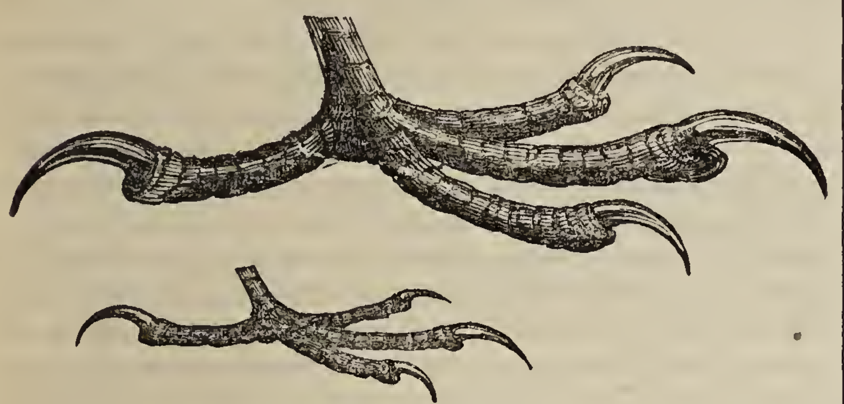
Common Fowl.

Some have the tarsi plain, some with a soft tubercle, and some with a hard and sharp horny spur. These naturally belong to the males only; but, from physiological causes, they are sometimes produced on females.

Feet for walking and perching. The feet of the omnivorous birds are generally of this description, and also most of those of the granivorous—as all of them feed on the ground at some seasons, and most of them perch occasionally. The foot has three toes before, and one behind, all articulated on the same level, and divided at their bases. This is not so firm a foot upon the ground as that of the gallinaceous birds; and the march of none of them is so stately as that of some of these. The axis of the body rolls more when they walk; and many of them, when urged to speed, hop, and also call in the aid of their wings.

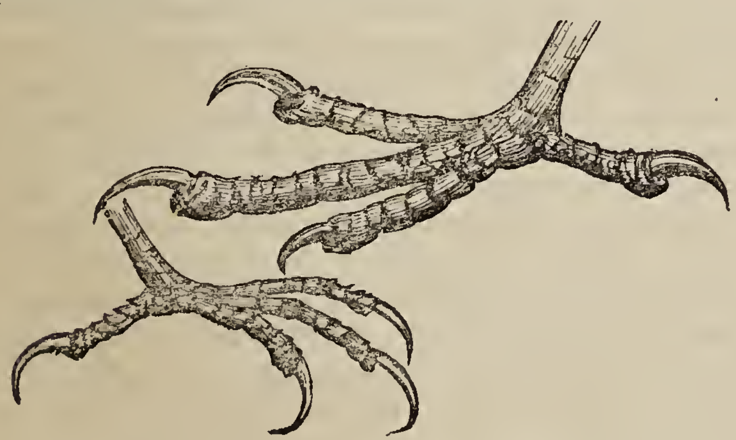
This want of firmness in walking arises from the absence of the connecting membrane at the bases of the toes, and also from the toes themselves having more play at their articulations. But the very same circumstances render it much more efficient as a perching foot; and while the gallinaceous birds can, in general, only roost across a perch of considerable thickness, many of the free-toed birds can hang in all positions, and by one foot or both, as need may be, from a slender vibrating stem.

Generally speaking, the omnivorous birds are the best walkers, and those which eat small seeds from the stems of plants the best perchers; but there are exceptions. The rook is one of the best walkers; and the tits are among the most dexterous perchers: so that their feet may be taken as examples.



Rook and Blue Tit.

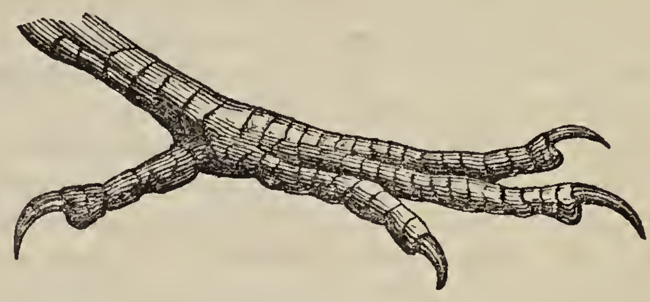
Feet better adapted for perching than walking. Birds with feet of this description are generally those tribes, wholly or chiefly insectivorous, which seek their food partly on the ground and partly on the leaves of trees; which are generally seen on trees and bushes, but which perch generally, and have no peculiar mode of action on the trees. This foot has three toes before and one behind, but the outer front toe is more or less joined to the middle one at its base—sometimes at the base only, and sometimes as far, or nearly as far, as the first joint. This structure of foot gives the bird more firmness when perching across a twig than those birds have in whose feet all the toes are free; but they have not so much action on their perch, and cannot swing about so much as the birds with free toes; and they are by no means so good walkers. There are, however, considerable differences among them; as, for instance, the song-thrush, which finds its food on the ground, is rather a good walker, while the crested wrens, which reside almost constantly in trees, have not much less command of themselves than the tits. The feet of these two species will serve as illustrations.



Song Thrush and Golden Crested Wren.

All the migrant, and some of the resident warblers, which sing from the groves and copses, and make the vernal season so lively with their music, have feet of this structure; and they all sing on the perch, and not on the ground or the wing.

Syndactylic feet. These have all the three front toes united together. They feed chiefly on the wing, use the perch only for rest, and walk little on the ground, for which the form of their feet very ill adapts them, though they usually have their nests in holes, and often in holes excavated by themselves, for the digging of which their united and spade-like feet are by no means ill adapted. The foot of the kingfisher will illustrate this structure.



Kingfisher.

Crab feet. These are feet of a very peculiar structure, to which writers on ornithology have given no name; and yet they are distinct from any other feet, and their mode of action is very peculiar. They belong to the *Fissirostres* of Cuvier—the *Chelidonian* birds, or swallow tribe, which are so well marked, and so distinct from all others, both in their structure and their habits, that they ought not only to stand as a separate family, but as a separate order; and the three genera, of which the group is composed, are so different from each other, that each ought, in strict propriety, to form a separate group, or even sub-order.

The birds to which they have the nearest resemblance are the fly-catchers, but the resemblance is not a very close one, except in some of the foreign species of goat-sucker; and then, so far as the habits are known, even these are very different.

All the three leading organs, the bills, the wings, and the feet, are so peculiar in these birds, that almost any of them might be made the ground of classification. The wings are the most powerful part of the organisation, more especially of the diurnal ones; but even the feet are very characteristic. They are not walking or perching feet, they are simply adhering ones; and though both the tarsi and the toes are comparatively small and feeble, they are very beautifully adapted for retaining their hold, be the position of the body what it may.

Though the description of prey is very different, and the feet are probably never used in the capture or the killing of it, yet there is a remarkable analogy in habit between these birds and the birds of prey; and this analogy holds even in the division into two sections. All the swallow tribe are diurnal feeders, feeding wholly upon insects, and capturing them on the wing only, and by the snap of the bill, the sound of which may be often heard when the birds are on the chase. They are thus hawks, only they are hawks in miniature; and there is nearly the same distinction between the swifts and swallows as there is between the falcons and the short winged hawks. The habits of the nocturnal ones are not so well known, as the habits of nocturnal birds are much less open to observation than those of diurnal ones; and, therefore, it is not ascertained in what manner they capture their prey, though probably by the bill, which is even wider in the gape than in the day-feeding species; but as the foot of some species at least is different, they *may* use that in some instances in the capture of their food. As they feed in the twilight, they must feed in part on moths; but that is also the time when the larger coleopterous insects are on the wing; and these may require preparations for the stomach different from what are requisite in the case of the naked winged insects, which form the principal food of the swallow tribe. Still, in the form of their bodies, in the texture, and even in the colouring of their plumage, the nocturnal species differ from the diurnal ones much in the same way that the owls differ from the nocturnal birds of prey.

There is even a similar distinction in respect of habitation. The diurnal species, like the diurnal birds of prey, are all dwellers in open places, and they do not nestle in trees: the nocturnal ones are copse or woodland birds; and though some of them are understood to nestle on the ground, the greater number certainly nestle in trees and bushes. Yet further: the diurnal ones have a harsh, sharp scream, which though not exactly like the chirrup of hawks, has some resemblance to it; and they are in general silent: the nocturnal ones, on the other hand, have a more continued and stridulous cry; and in the depths of the tropical forests, especially those of America, they keep not only the common night, but the sultry and otherwise silent night of the burning noon, alive with their cries.

Being all chiefly insect feeders, they are most abundant in tropical climates; and those which frequent cold and temperate regions in the summer always quit them before winter. The nocturnal feeders, being birds of less firm feather and less powerful wing, are by no means so migratory as the diurnal ones. These last, as will be more particularly shown when we come to give some account of wings, are among the most exclusively wing-birds, and the best winged in the whole class. Their food is in smaller portions than that of any of the class, and therefore they have more labour in the procuring of it. Not only this, but many of them have much labour in the construction of their nests, whether they build them of mortar in the crevices of rocks or the apertures or angles of buildings, or excavate them in the banks; and all of them have much to do in the rearing of their broods, which, as is general with birds that have very perfect feathers, continue a long time in the nest.

Their feet more resemble the syndactylic ones than those of any other form, though these have the toes united, and consequently a narrow foot, while the birds under consideration have one remarkably broad for its length; but they both agree in this, that the tarsi and toes are short, and they use the feet only for resting or holding-on, and rarely if ever for progressive motion. It is worthy of remark, as a striking instance of agreement in two very important habits, that though the syndactylic birds build low, and the ones under consideration build high (for even the sand-martins, or bank-swallows, build in lofty banks and rarely in low ones), they should both have covered nests, and both feed their broods for a long period, as well as both capture their prey on the wing. And the height at which they build corresponds to that at which they fly. The kingfishers and bee-eaters never have their nesting-hole far above the surface of the water; and their flight, when in search of food, is invariably low. Of the swallow tribe, again, the sand-martin, which builds in holes of the banks, is the bird of lowest flight; and the flight and position of the nest rise together, till we come to the swift at the top of the sky with the one, and the top of the rock or the tower with the other.

The feet correspond: the syndactylic foot, with its soldered toes, forms a steady base for resting by pressure upon a horizontal perch; and the foot of the swift, which is the opposite extreme in all the birds which prey upon insects on the wing, is the best adapted for holding-on upon the slightest inequalities of an upright surface. Although, therefore, the feet of all these birds are small, apparently feeble, and not adapted for locomotion, there are no feet better adapted to the habits of their owners.

The general character in which the "crab" foot, or foot of the *Fissirostres*, differs from that of all other birds, is the equality of the three front toes, and the reversibility of the back one. In most birds the middle toe and the external front one, have each four phalanges of bone, while the inner one has only three, and in some of them, more particularly in the zygodactylic birds, the feet of which remain yet to be noticed, the outer toe is reversible backwards, so that it acts in concert with the hind one and in opposition to the other two. But in the crab foot, the back one is reversible, so that all the four points can be turned forward, or rather into the circumference of a circle, in which the articulation of the toes with the tarsus forms a fifth point.

The feet with the reversible outer toe, have the strongest action in opposite directions toward the centre of the foot, and therefore they grasp firmly any substance to which that is applied, although the tarsal joint is straight, or even the bird suspended by the leg at full length, or standing up with it in the same position. But the greatest action of the crab foot is concentrated upon the articulation of the tarsus in one direction only, and that is the direction against which the weight of the bird pulls. The tarsal, and also the tibial joints are bent as far as they will bend, when these birds hold on upon the upright surface of a rock or wall, and the articulation of the toes is, at the same time, in contact with that surface. Therefore, if there is the least hold for the points of the claws, the strain upon them is always such as to make them retain that hold the more firmly the greater the strain.

Upon carefully examining these feet, of which the most perfect is that of the swift, a figure of which will be found in the sequel, it will be perceived that, while the spread of the toes gives great stability to the individual foot, the two are, when the bird hangs, or adheres by means of them, so placed as that the greatest resistance of each is in the direction of the centre of gravity of the whole bird, so that the weight actually draws them into close contact with the surface of which they have hold. If in common mechanics, it were required to find an instrument consisting of hooks which should be the best for holding on against a strain, parallel or nearly parallel, to the surface on which it held on, the very best model would be the foot of the swift. The pull upon the individual toes, being toward the point of their general articulation, draws them together so that they clutch the surface upon which they have a hold; and then the strain of the bird's weight pulling upon each foot toward the centre of gravity of the whole body, acting in two lines, which, produced, pass a little outwards of the average hold of the feet, makes the whole bird hold on with the feet, as if it were grasping or embracing a substance between them.

The goat-suckers, being more woodland birds, have the feet better adapted for perching on twigs or other horizontal supports, than the swallows. They have a short membrane, connecting all the anterior toes at their bases, and the middle front toe is longer than the others, and the claw pectinated.

There have been various speculations about the use of this pectinated claw, some of them more and some less ingenious, but none of them very much to the purpose. That it does not in any way assist the bird in perching, is proved, not only by the fact that the toe which has it does not close so completely on the terminal phalanx as the other toes, but by the general principle in nature that animals never hold on firmly by means of teeth or pectinations in one continuous inflexible member, in maintaining the stability of their own position. A single adhering point to each moveable part of the organisation, is that which makes the hold the most secure, because it is the one which allows the greatest play in all directions. Accordingly, in the articulation of animals, whenever we find a joint upon which there are to be cross motions, we always find the socket, and the head which plays in that socket, simple, while, in those which have motion in one plane only, the head and socket are often both double, and not unfrequently ridged in addition.

The speculations which have been made with regard to the use of this pectinated claw, are hardly worthy of repeating. That of White is the most sagacious, because most agreeable with the general analogy of nature. He says merely, that it appears to be to aid the bird "in taking its prey;" as the heron holds its slippery prey with a pectinated toe, and mergansers and several other birds hold theirs by serrated mandibles. But it has been also said that this toothed claw is used in trimming the vibrissæ or hairs at the sides of the gape, and also in clearing the bird of troublesome insects.

The hint thrown out by White is that of a naturalist—of one who seeks a new use for a new form of organ; the other conjectures hardly deserve that character, as they point at no additional use for the additional structure, inasmuch as there are birds with plain claws which live on similar food, and are more infested by nirinides than the goat-suckers. White's hint points to inquiry, the other conjectures do the reverse—they lead from nature to art.

The goat-suckers themselves, though otherwise noisy enough, are silent upon this subject; and as the mode of their preying, from the time at which it usually takes place, is not very open to observation, it is difficult to come at the truth by observation. But, from the time, and, as far as it can be observed, the manner of their feeding, the goat-suckers must feed upon beetles and moths, insects on which there is a considerable quantity of substance not available as food; and as, though there are *some* points of resemblance between goat-suckers and owls, no mention is made of the former returning the elytra of beetles and the wings of moths in castings, as the owls do the indigestible parts of their prey, it is not improbable, though certainly not proved, that they may use the pectinated claw in removing the indigestible parts before they swallow the rest. It avails little, however, to speculate upon the use of a structure which we have so limited means of observing; but we may observe in passing, that though Wilson saw these birds scratching their heads with the pectinated claw, that proves nothing as to the specific use of the pectination, because birds which have not their claws pectinated, scratch themselves in a similar manner, and this one cannot alter the form of its claws while performing this operation. It must, to use a homely phrase, scratch itself with such claws as it has; and as no bird appears to have claws specially formed for this secondary purpose, the analogy is against such being the principal intention of this toothing of the claw of these birds.

Upon looking back at the figure of the goat-sucker's bill, it will be perceived to be very *fissirostral;* and that, though it might be capable of transfixing a tough coated insect with the sharp points of the mandibles, it cannot bruise any thing between the tomia. The sharp points are obviously for capture; for though there are vibrissæ along the edge of the upper mandible, there are similar hairs at the junction of the upper mandible with the front, where they cannot by any possibility assist in the capture of the prey, and there are also similar bristles at the base of the bill in many birds which do not catch insects or any thing else with the bill while they fly open-mouthed; so that it is at least probable that while the coleopterous insect is seized and held between the hard and sharp points of the mandibles, the parts that are unfit for food are stripped off by the pectinated claw of the foot, which is certainly borne less bended, or in advance of the other claws. The following figure is an accurate representation of the foot of this bird.

Goat-sucker.

The swallow-tribe all have the foot less firm as a perching foot, that is, less connected by membrane between the bases of the toes, than the goat-suckers; and the articulations of the toes with the tarsi have more of the ball and socket form, and consequently admit of more motion. This motion increases, and the tarsus and toes become shorter, and the claws more crooked, from the lowest building swallows to the swifts, which have the most perfect crab foot, that is, the one best adapted for individually holding-on upon slight inequalities of a perpendicular surface, and at the same time the least fitted for perching on a twig, or walking upon the ground, for which last office they are not at all fitted, and the birds are consequently quite helpless there.

The feet, admirably formed as they are, are not the only organs by means of which these birds maintain their perch upon perpendicular surfaces. The flying feathers of their wings and tails are remarkably stiff in the shafts and firm in the webs; and though they cannot, of course, take hold with their feathers, unless when they, as it were, embrace a projection, yet the pressure both of the wings and tail assists in tightening the hold taken with the claws; so that, even though the surface to which they cling overhangs, these birds can stick to it very firmly. The annexed figure of the swift's foot will show the structure.

Swift.

Anisodactylic feet.—As "crab" feet, more especially in that form which they have in the swallows and swifts, are the best fitted for holding-on while the body generally of the bird is steady, upon an upright or an overhanging surface, so feet of the form now to be described are the best adapted for motion upon such surfaces. Birds which have them are all, generally speaking, tree birds, or at all events woodland birds. But, like the birds with feet of the immediately preceding form, they admit of subdivision into those which feed more exclusively upon the bark of trees, and those which feed more exclusively on the wing. They are the same or nearly the same as the tenuirostres of Cuvier.

But, although that illustrious naturalist has taken the form of the bill as their distinguishing character as a tribe, and though their wings, which are in general very powerful, might also be made both a general character of the whole and a means of dividing them into different sections, yet the foot is unquestionably their most prominent and remarkable character. Their feet are entitled to the preeminence, not because they are, as in those birds which cannot fly, the only active organs except the bill, and not because they are efficient organs of locomotion upon the ground; for, generally speaking, these birds are not only very bad walkers, but they are seldom, if ever, found upon horizontal surfaces. Indeed they are not at all adapted for such surfaces, and those of them which have their own peculiar feet in the greatest perfection, are as helpless upon the ground as the swifts.

But their feet can adhere to, and, with the assistance of the wings, move along any surface, be its form or position what it may. Those which are bark birds can run along the boles of trees, upwards, downwards, or round by a circular motion; and others, again, can hang by the feet to the petals of flowers, while the bill reaches the bottom of the nectary, and sips the sweet juice which accumulates there, as is well exemplified in the humming-birds and the nectar-suckers.

The structure of foot, by means of which this singular command of all manner of surfaces is obtained, is apparently a very simple one; and if we had not so many instances in nature of the cleverest action performed by organs apparently the most simple, we should never imagine that the apparently small difference of structure that there is between the feet of these birds, and the feet of birds which cannot climb at all, could be sufficient to effect so great a difference of action. The ordinary appearance of the foot, when in a state of repose, is three toes to the front, and one behind, the same as in an ordinary walking foot, only the middle and external toe have a union at their bases which appears to be something more than a merely membranous connexion, like that of many of the insectivorous birds. It is, however, in these two toes, their union and the peculiar mode of their articulation, that the whole peculiarity of the foot, that to which it owes its wonderful climbing power, consists. These two toes form a sort of second foot, which can act upon its own articulation in opposition to the two remaining ones, that is, to the interior front one and the back; and the joint by which the two are articulated on the tarsus admits of so much and such varied motion, that the one part of the foot can act in any direction against the other. Owing to this, the action of the foot is universal as to direction, parallel to the axis of the body, or almost at any angle to it. Thus the birds can run upon the bark of trees in any direction, holding on upon the irregularities of the bark with each foot, and at the same time embracing the convexity with both. This can be easily understood, when it is considered that both the recurved toes of each foot press inward towards the centre of the body; and this action of the two feet in opposition to each other converts them into a sort of one clutching foot, which acts without any direct exertion of muscles, and therefore holds on for a long time without being in the least fatigued.

Anisodactylic feet are thus formed for concentrating their action upon the centre of the body, without any reference to the direction in which the weight presses, just in the same way as the crab feet of swifts concentrate their action so as to support the centre of gravity in the most effective manner.

The best native example which we have of a bird with this clever species of foot is the creeper, or the common tree creeper (*Certhia familiaris*). It is a very small bird, the smallest that we have in these islands, with the exception of the crested wrens, which, like it, are tree birds, and very clever on their feet, although they are perchers and not climbers. It is a resident bird in Britain, and by no means a rare one, and its motions upon the trees are well worthy of observation. The direction in which it runs (for its motions, though aided by the wings, have more the appearance of running than of any thing else) appears to be of little consequence. Upwards or downwards upon the bole of the tree, outwards or inwards upon the branches, with the back or the belly uppermost, appear to be all the same to it; but, from the celerity of its motion, and its diminitive size, it is not easily seen. The nuthatch, of whose foot a figure is annexed, is the only other species resident in Britain, though the hoopoe, which is a very handsome bird, with feet nearly of the same character, appears not unfrequently as a summer visitant.

Nuthatch.

The hoopoe differs, however, in many of its habits, for it is more of a water bird than a frequenter of trees, and its bill is incapable of performing labours so severe as those of the nuthatch, or even of the creeper; for though the last is an insectivorous bird, and not able to hew the shells of nuts to pieces like the nuthatch, it has to dig its food out of the crevices of trees.

The different substances upon which birds with feet of this structure feed, is strong evidence against the classification of them by the form of the bill; because, if such a classification is to mean any thing, it should mean similarity both of food and of manner of feeding. But though most, if not all, of the birds which have feet of the structure under consideration have slender bills, their food is very varied, and the only habit in which they all agree is that of being able not only to adhere by the feet, but to move about upon almost any form of surface, or in almost any position.

Considered as mechanical structures, acting in concert with the whole organisation of the birds, these are, perhaps, the most extraordinary of all the varied forms which birds possess. They act in concert with the whole structure of the birds; and thus, though the mechanical contrivance that appears in them, taken singly, is not very striking, yet it becomes remarkably so when we consider bird and foot jointly, and notice how the varying pressures which the weight of the body gives in all the numerous positions which it can assume, contribute almost equally to render more firm and sure the hold taken by the feet. One of the greatest beauties in those displays of the mechanics of nature, and one of the greatest superiorities which they evince over all that human ingenuity can contrive, is the wonderful simplicity with which what, to us, seems the most difficult of all purposes, is accomplished. When we have a mechanical difficulty to overcome, we complicate part upon part, and often defeat our object, because the artificial clogs and hinderances which we thus produce, are greater than the difficulty which we sought to overcome; and thus we produce a negative effect instead of a positive one, and are further from our object at the end of our labour than at the beginning; but when we examine nature, we find that the very difficulty itself becomes one of the most effective means by which it is overcome,—as in the case of these singularly footed birds, the weight which the feet have to sustain is actually converted into a means of sustaining it.

Scansorial or climbing feet.—The principal object to be accomplished by these feet, is not simple adherence to an upright overhanging surface, as in the case of the swallows and swifts, or progressive motion along the boles and branches of trees, as in that of the *anisodactyli*. It is, in the more perfect specimens, motion from branch to branch, and in the others stability on the boles of trees, with the body in an upright position. Feet which accomplish these purposes are all *zygodactylic*, or yoke-toed, that is, they have the outer toe very readily reversible, so that the foot presents two toes to the front and two to the rear, both nearly of equal power; and where there is a different function to be performed, that is done chiefly by modified articulations of the other parts of the foot and leg.

The extremes of this kind of foot are perhaps those which are found in the woodpeckers and the parrots. The woodpeckers are trunk birds, and when upon trees, they are insectivorous; the parrots, on the other hand, find no food upon boles or large branches, but subsist chiefly upon fruits, and ramble about among the smaller twigs and sprays in quest of them. Thus, though both are climbers, they climb so very differently, that when they are described as birds of the same habit, a person who knew only one of them would be apt to form a very inaccurate notion of the other. The woodpecker cannot climb as the parrot climbs, neither can the parrot climb as the woodpecker. The woodpecker is a bark bird; and though it can adhere to the bark of a tree, so as to leave its bill, neck, and head free for other action, it cannot adhere in an inverted position; and unless the crevices of the bark are particularly favourable for its claws, it must use the stiff feathers of the tail as a prop. Whether it requires to do this or not, it must always bend the joints of the leg so as to make the claws hold with the requisite firmness. Its foot is in fact a sort of double crab foot, the two parts of which hold on in opposite directions. It is by the claws which are turned to the front that the weight is suspended; and those which are turned to the rear, have their principal action in tightening the hold of these. Then the line of the body and tail acts in the same manner as a diagonal strut under a beam; and every one knows how small a hold in the wall will support a beam if such a strut is applied to it. The painter's scaffold, used in cleaning or repairing windows high above the ground, which one sees every day in the streets, acts upon a principle nearly similar to that of the woodpecker. The following is the position of the foot when in the act of holding on.

Woodpecker.

The foot of this bird has other functions to perform besides keeping its hold on the bark of trees. It is an insect-feeder, and at certain seasons these are much more abundant on the ground between the trees, than in the trees themselves. The seasons when the larvæ are in the bark or the decaying wood, and when the mature insects resort thither to deposit their eggs, are those at which the woodpecker is most active upon the bark; but there is an intermediate time during which the bird is on the ground picking up beetles, and especially ants, which last are gregarious or social insects, and great frequenters of forests. In temperate countries, woodpeckers answer, at those times, nearly the same purpose which ant-eaters answer in more tropical climates.

This habit in the woodpecker requires a command of itself upon the ground for which the parrot has no necessity; and which, indeed, would be incompatible with perfection in that peculiar structure of foot which the parrot requires. Accordingly, although the woodpecker does not require to be a runner, inasmuch as food for it is very abundant at those times when it is on the ground, yet it stands well on its legs, and is a tolerable walker; while on a level surface the parrot makes sadly shambling work of it—much like that of a climbing ape, and it very soon gets fatigued, which the woodpecker does not.

Though three toes before and one behind, all free at their bases, be the normal foot for a continued slow pace on the ground, yet the form of the toes is not that which constitutes a walking foot. The relative lengths of the bones, and more especially the articulations of the foot and leg, are the chief points which render the foot either a good walking one or not. If these joints have these motions only in the vertical plane and parallel to the mesial plane of the body, without any lateral flexure, then the bird will walk firmly; and whether its march shall be quick or slow upon one kind of surface or another is made out by the details, the relative length of the member, and the form and magnitude of the toes and claws. If a man has his knees or his ankle-joints with lateral play, or with a twist inward at the knees, or more especially with a twist either way at the ankles, he walks never a bit the better though his feet may happen to be, as is often the case with inward-twisted ankles, as broad as shovels. It is also impossible even to imagine members more finely organised for their proper use than the toes of long-armed apes and spider monkeys; and yet, from the twist of the ankle, which is an outward twist, or one which turns the sole of the foot inwards, they walk not only with great awkwardness but with great pain.

The articulation of the toes of a bird, answers in anatomical arrangement to the ball joints of the toes in man; but in the act of walking it answers to the ankle-joint. If this joint is firm, and the joints above it so articulated as that the weight of the bird comes perpendicularly upon its centre, then the step of the bird will be firm; but if this joint is loose, or even if the strain takes it in an oblique direction, the bird will wriggle or waddle, and waste in rolling from side to side great part of that muscular exertion which would carry a better set bird straight forward on its way. The woodpecker is straight and firm on these articulations; and even its capacity of holding-on upon the trees, requires that it should be so. It is not, as we have seen, a clutching climber, which holds on by grasping with the foot,—for even when the woodpecker perches upon a branch for repose, it does not perch across, as most perching birds do, but lengthways, or with the axis of its body parallel to that of the branch,—it holds on by a combination of mechanical resistances, acting all in the same plane, though in different directions; and therefore any lateral motion in the joints of the foot or leg would turn that foot into an instrument of positive instablity—a crowbar to wrench the bird from the tree.

But when we consider the style in which the parrot climbs, we can easily perceive that that looseness and twist, of the articulation of the toes especially, which make it so bad a walker, are the very best for its proper habit. It is the same with the twisted-limbed mammalia to which allusion has been made for illustration; they could not have performed their part in the system of nature, unless they had had that very formation which makes them appear so awkward when out of their proper sphere. When we come to notice the feet of the water-birds, we shall find instances of structure differing from each other to the same extent, and nearly in the same manner as these differ; and if it lay within our province, we could easily show the very same differences of adaptation and use, and the same perfect accordance of the one with the other in all animals endowed with locomotion, whether vertebrated or invertebrated, and whether of the magnitude of whales or the minuteness of animalculi. Throughout the whole there is the most complete evidence of mechanical perfection, always competent to effect its purpose without supplemental aid. And among most of those cases, probably indeed in every case of an articulated animal, whether articulated internally in the skeleton, or externally in the crust, where it has been supposed that suckers and cements and other clumsy contrivances have been resorted to in order to enable the animal to keep its hold, a very few simple claws, or elastic pads, applied with nature's mechanical skill, are not only all that exist, but all that is necessary, and that more would be an absolute incumbrance.

Those attempts at explanation by such supplemental aids as have been alluded to, are found in numbers in very many of the books (even those of no measured pretence) which profess to treat of the mechanics of the living world. But the accounts of such structures always point out the origin of the structure: it is a bungle; therefore it is the work of man: were it the work of God, it would be perfect in its single and simple organisation, and more, even could it be added, would overload and weaken it, just as a machine of human invention is overloaded and weakened when it consists of too many parts. That joiner is a bungler in his art who must upon all occasions use the glue-pot; and that is the most perfect piece of carpentry which stands firm without glue or nail or any other supplemental fastening; and when we come to nature we find no such fastenings; the parts themselves have the requisite form, the requisite adherence to each other, and the whole, by means of its own organisation, has the necessary adhesion to whatever kind of surface is to support the animal in its ordinary motions.

And here, as the subject presents itself naturally in consequence of the explanations which have been given of these feet, we cannot resist calling the attention of such readers as may not generally be in the habit of attending to such subjects, to the very wide and wonderful field for mechanical study which the animal creation presents. Yet ample and apparently exhaustless as it is, it is all acquireable knowledge, as far as the telescope can survey in the one direction, and the microscope in the other.

The organisations of animals do not partake of the unseen and therefore the mysterious nature of that energy of life by which they are evolved and put in motion. They are, in all their parts, wholly material, and every motion, and every position of rest, of which they are capable, admits of as certain explanation—an explanation as simple, if we would go the right way to it, as the putting of a common balance in equilibrio, by placing equal weights in both scales. A leech may proceed by suckers, but no animal proceeds thus, unless its principal action in motion is a lengthening and shortening of the body; and when we say of a swift-footed animal, that it must pause at every step, and either fasten its foot by glue, or by pumping out the air from under it, we afford a very certain proof, not only that we are imperfect in the knowledge of nature's mechanics, but that we do not understand the meaning and application of those common laws of mechanics, which are set down in the books, although we may be able to parrot the enunciations. When we do not understand by what means, or in what manner, an animal, or a particular organ of an animal, which is new to us, and, philosophically speaking, everything which we do not understand is new to us, though we should have been in the habit of seeing it daily for the longest life—when we do not thus understand, the most candid, and by far the wisest plan, is to say so, because all mankind like candour in others, and thus we win the applause of the whole world, without any admixture of that envy or jealousy, which is just as apt to follow a false discovery as a true one; and besides, we leave uncloyed, and in full vigour, that appetite by which alone we may come at the true knowledge. But to return to the scandent feet.

The foot of the parrot is a foot which climbs by clutching—a "tying" foot, as one would say—and not one which holds on by a combination of "counter-strains," like that of the woodpecker; and it is so, in order that the owner may find its food in situations where a woodpecker, or, indeed, any bird differently organised to a parrot, could not subsist. The pasture of the parrot is among the sprays or smaller twigs of large spreading trees, and not exactly at the extremities of them, because the fruit which is fit for the parrot's eating is rather farther in, there being a new shoot beyond the fruit before it is ripe, in most fruit trees, and a new shoot with green fruit, and often another with blossoms beyond it, in many of the fruit trees in parrots' countries. Besides, many of those trees bear their fruit at the axillæ of the twigs or leaves; and as the same point of a vegetable never blooms or fruits twice (so that the most perennial trees in duration are really annuals in their most important functions), the successive fruits or flowers are, even in these, without the place where the parrot feeds. Some of the allied genera alight on the tops of the trees, but these are the long-tailed ones, which are better winged, more in the habit of flying, and less expert climbers than the true parrots; and even they do not penetrate so far into the sprays as where the parrot feeds, and they feed upon fruits of a different character—fruit of which the pips, not the pulp, is eaten.

Now, any one who examines a tree, when so cleared of leaves as that the twigs can be seen, must perceive, that at about the situation of the previous year's shoots, the twigs, even when leafless, are so tangled, that no bird half the size of a parrot could use its wings among them, unless to pass through at some opening; but the parrot has to range the tree in all directions at the very part of it where wings cannot be used; and it has to range minutely, because there are always leaves upon those trees, and the leaves of tropical trees are often broad and close. Thus, though the parrot is a tree bird, it seeks its food much in the same manner as a partridge seeks among the corn, or a grouse among the heather; that is, by comparatively slow motion, and prying about on all sides as it goes along. Consequently, the organisation most essential to this habit is the one which enables it to get most readily from twig to twig without the use of its wings in any other way than partially opened to assist in keeping its balance.

The foot, to possess this property, must have the whole of its prehensile action in the toes; and the leg, instead of maintaining one invariable position in assisting the foot in holding on, must be free to move to its utmost stretch in all directions. It is also evident, that unless the parrot could hold on by one foot, and hold on with that foot in any direction, above it, below it, or laterally, it could not make its way; and even in addition to this, the bill of the parrot is prehensile, and affords the same assistance to the feet as the prehensile tails of those climbing mammalia and reptiles which have that character.

To accomplish these purposes, the joints in the leg and foot of the parrot must have rolling or oblique motions, in order that, while it holds on with the one foot, it may extend the other as far as its length will permit in any direction; and it is especially necessary that the joint at the articulation of the toes should turn the foot outwards, because that is the best position for its readily laying hold. When the necessity that there is for its action is known, the action itself may be easily inferred from inspection of the annexed figure.

Parrot.

Swimming Feet.—There are not so many diversities of form in the feet of aquatic birds as in those which inhabit the land, whether they seek their food on the earth itself, or upon vegetable substances. The element is the same, or nearly the same, in all water birds, so that the only thing which remains to which the feet have to be adapted is the difference in habit among the birds themselves. There is, however, one difference of element which requires a corresponding modification of the foot: there are some birds which are very exclusively in the water, and, as such, water birds, in the form of their bodies and the manner in which their feet are articulated; but they frequent those waters which are full of the stems of reeds and other aquatic plants, among which the structure of foot which is best for action in the clear or open water, would, of course, not be the most convenient. The foot for action in the open water is a continuous web of membrane between the toes, which varies with the habit of the bird; but among stems this web could not be so conveniently used, as it would be liable to get entangled or interrupted, if not torn. Accordingly, these birds have the toes only lobed, so that they can be drawn through between the stems with the less opposition. Some of the birds which have these partake of the character of shore or bank birds, and can walk upon the land as well as swim upon the water. These are the coots and phalaropes, which continue the succession from the gallinules, which, through the landrails, have some relation to certain species of the gallinaceous birds. They, when on land, carry the axis of the body in nearly a horizontal position; and the lobes on their toes are divided into segments answering to the phalanges. Of these the foot of the common coot is an instance.

Grebes, though chiefly frequenters of fresh water lakes, have much more aquatic habits. They have the body of the true canoe shape, and the legs articulated so far backwards, that they cannot support the axis of the body in a horizontal position upon land. They accordingly walk with the spine nearly erect; they walk with difficulty, and are never found far from the water. Their feet have complete lobes to all the toes, and even the tarsus is flattened, and has a membranous margin, so that the foot is a swimming foot all over, though one adapted to peculiar places. The articulations of the tarsi have a rolling motion, and those of the tibia also work outwards when the feet act in swimming. The looseness of these two joints renders the bird incapable of moving along the ground with the legs steady; and this, more than the mere form of the lobed toes, is the reason of its being so bad a walker.

But the feet are admirably fitted for aquatic motion. They turn their thin edges nearly in the direction of the resistance when they are drawn forward, but they strike back with the full breadth of their webs, and they can turn on the joints so as to give the stroke in a variety of directions, and thus impel the body upon any course which may be necessary to the bird in following its prey in the water. The wings also come into action in swimming, though more as points of support, against which the legs act, than as propelling organs. But the birds are altogether excellent swimmers, or rather coursers through the water with great speed. They do not dabble like ducks, but plunge freely into the water, and dash along, not by alternate strokes of the feet, as in a common walking motion, but by striking with both at once, as a frog does. It is to enable them to perform this motion that the wings are brought into action as well as the feet; and the same kind of motion could not be performed, and the intended course kept, without the wings. This is, in part at least, the reason why those aquatic birds, which are incapable of flight, have the wings, though destitute of flying feathers, much more produced and capable of motion than those of the running birds upon land. The different styles of motion through the water, whether on the surface or below it, can, however, be more briefly, as well as clearly explained, when we come to consider the habits of those birds which have entire webs on the feet, and range the water in places where they are not liable to interruption from the stems of plants.

Grebe.

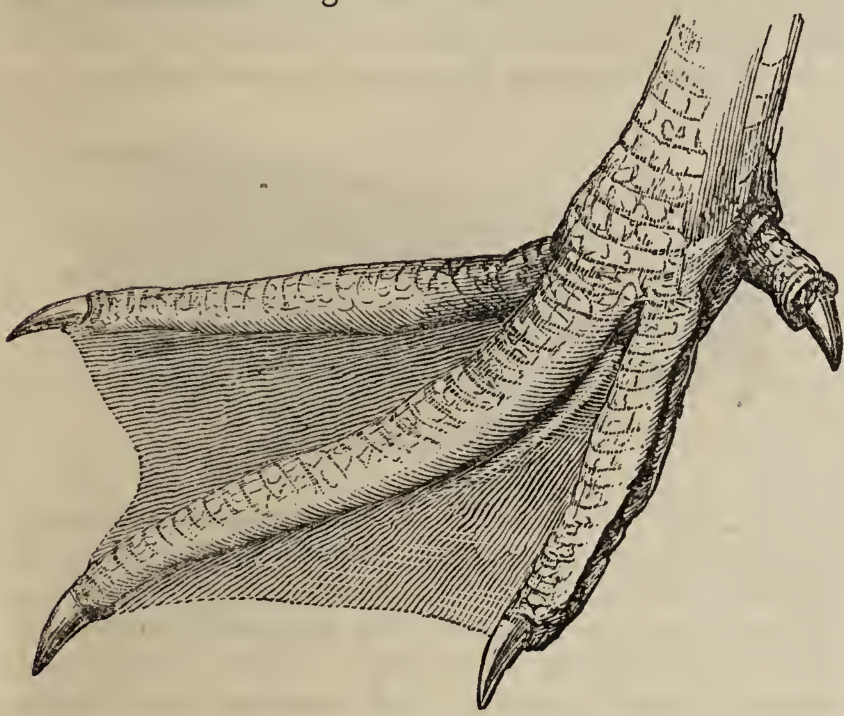
What may be considered as the normal swimming foot consists of three toes directed to the front, and one small one to the rear. There are always webs of membrane between the front toes; but in the species which swim only and do not dive, there is no web to the hind one. Divers have it marginated with a small web; those birds which Cuvier styles *totipalms*, or entire feet, have the hind toe much longer and stronger, and included in the same web with the anterior ones, and they have the whole foot turned in a particular direction, the purpose of which will be explained afterwards; and there are some genera which are in the habit of tipping the surface of the water with their feet, while their bodies are nearly or altogether supported by the wings in the air, and these have the hind toe merely rudimental, and the foot narrower in proportion than any of the others.

In order clearly to understand the uses of the different forms of web feet, it is necessary to consider the other actions of the bird to which the foot must be subservient, or at least with which it must be in accordance. These actions are of course either walking or flight; though they also admit of modification. Thus, if the sea-bird alights only on solid surfaces, it requires the feet to be somewhat different than if it alighted on soft ones; and if it dash at once down on the water from high flight, it requires the feet to be different from what would be more convenient if it launched itself in a direction nearly parallel to the surface. Also if the bird is in the habit of walking much, it is necessary that the feet should retain a considerable degree of that action of all the joints in one plane, which we have already shown to be necessary to the stability of a walking motion. If the bird combines the three motions of walking, flying, and swimming, in nearly equal perfection (and there are many birds which do so combine them), it is necessary that the feet should have a different structure; and if the motion is in the water only, the structure of the feet requires still to be modified according as it is more of a straight forward motion, or of an ascending and descending one.

There is, however, no bird with webbed feet which can have that perfect adaptation of the feet for walking, which is possessed by ground birds upon land; because every bird with webbed feet is a swimmer; and though the swimming motion should be merely a modification of the walking one, that is, by alternate strokes of the two feet and never by both at once, yet the articulation necessary for swimming is somewhat different from that which answers best for walking; because the swimming feet must throw out a little in order to clear the body, and this very throwing out, which does not cause the body of the bird to vibrate when it is supported by the water, does make it vibrate when it is in the air. Sea birds as well as sailors, may thus be known by the style of their walking; and though the causes be different, and the one habit and the other structure, there is such a resemblance between the rolling motion of the seafaring bird and the seafaring man, as alone would, to careful observation, point them out as dwellers on the same element.

The web-footed birds which may be considered as the least aquatic, at least among the flat-billed division, are the geese, especially such of them as, like the domesticated goose, graze the meadows, or otherwise find the greatest part of their food upon land. These have most of the walking character in their feet; and when they swim they never use any other than the walking motion, or that of paddling alternately with the feet.

But the body of the goose has a sort of boat, or rather punt shape; the sternum extends far backwards, and the tibiæ are so articulated that the tarsal joints project much farther from the sides than they do in land birds. Thus, though the axis of the body is borne in a position nearly horizontal, the advance of the foot, wide apart as the feet are from each other, does not carry the centre of gravity directly forward, but swings it round; so that, unless when the motion is very slow and the bill in contact with the ground, as is the case in feeding, the goose swings along with not a very graceful motion. Besides, though geese in their domesticated state are not much in the habit of flying, they are birds of long-continued and moderately rapid flight when in a state of nature. From this combination of feet and wings, and adaptation of the feet both to walking and to swimming, these birds have their muscles distributed over the body much in the same way as common poultry, and thus neither their feet nor their wings are very remarkably characteristic. The foot is a swimming foot of the simplest kind, and may be understood from the annexed figure.



Common Goose.

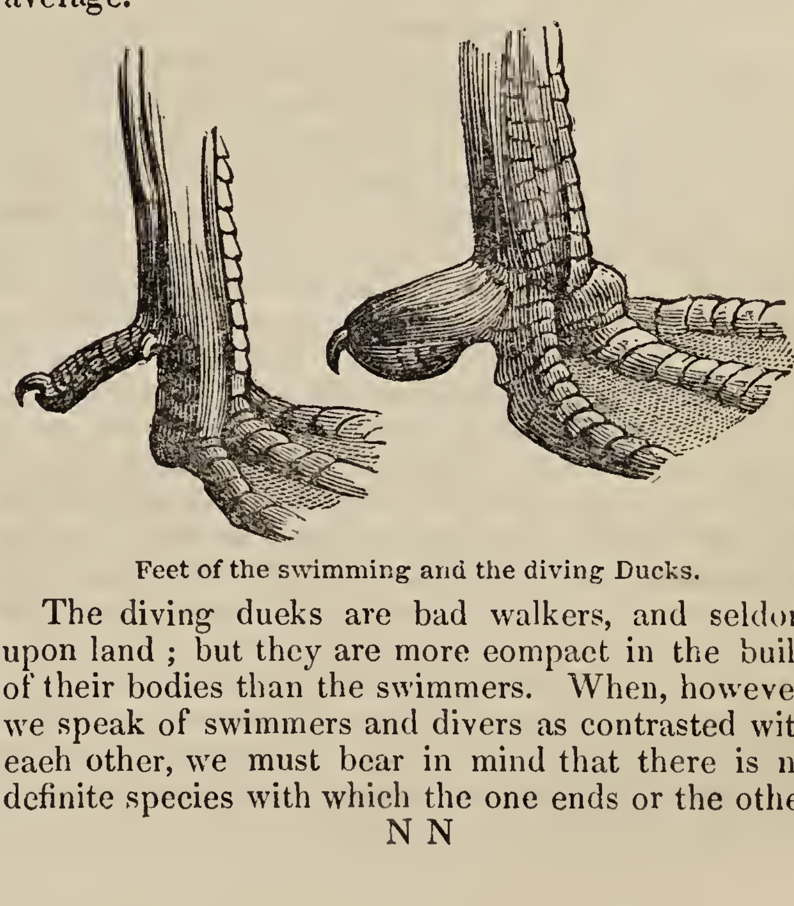
All merely swimming birds, which float along with part of the body above water, have the motion of the feet more nearly in the vertical plane than the divers. But there is, even in them, a very beautiful action of the foot, brought about by the mere bending of the leg, without any additional exertion of muscular power. The moment that they begin to draw it forward, after it has made the stroke, it begins to contract, by the bending of the tarsal joint pulling the tendon. The surface which the foot presents to the water in the direction toward which it is pulled, is thus not only constantly diminishing, but it is convex in its form, and yielding as the joints are relaxed, so that it "comes home" through the water with very little effort on the part of the bird. When, however, it begins to act in the taking of the stroke, it presents the concave side, and that side keeps enlarging till, at the time when the stroke is given, it has attained its greatest breadth. It then comes to nearly a horizontal position of the feet, and from this it is drawn forwards with not much more breadth than the edge to the water.

This foot is exactly a paddle, only it acts better both on the stroke and the return than any paddle which man can construct. No doubt the paddle which man uses is recovered through the air, and thus the resistance of the water is wholly avoided during that part of the operation. But still the exertion which has to be made in raising the paddle is much greater in proportion to the effect produced than that made by the foot.

The swan, though nearly or altogether equal to the goose in flight, is much less upon land in its ordinary habit, and it is accordingly better adapted for swimming, and, as a necessary consequence, a worse walker. Swans, indeed, stand in much the same relation to geese (taking them on the average) as the diving ducks do to the swimming ones. Their tarsi are shorter, the webs of their feet larger in proportion, and the joints have rather more oblique motion. As neither dive, the comparison of them is of course made as surface swimmers; and the attitude of the swan upon the water has been a favourite theme with poets and picturesque describers in all ages: and the bird is stately as well as graceful, both when it moves with closed wings and smooth plumage against the breeze, and when it hoists sail, and takes the wind in its raised wings, to aid or relieve the labour of its feet. From its beauty, its size, and its tameness, the swan is the best subject in which to study or observe the action of surface swimming. All its evolutions upon the water are worthy of notice, and its style of doubling and of backing is particularly so.

All those surface swimmings in which there is smooth motion are of course made with the alternate foot; for, as the feet are considerably in the rear of the centre of gravity, if the bird was to attempt leaping on both without something to hold on, the hinder part would be jerked out of the water, and the fore part plunged into it, by which means the progress would become both unseemly and fatiguing. When alarm, or any other cause, impels these birds to more rapid motion along the water than they can accomplish with the ordinary swimming motion at its full stretch, they take to the wing, and if they do not get so high as merely to tip the water with their feet, as the skimming birds do, they make the same flutter, and generally utter painful cries, as barn-door fowls do when forced to the wing.

The swimming ducks are less upon the water than swans, as a considerable part of their food is found on land, and they are incapable of reaching the bottom in so deep water. Their bodies are also not quite so well trimmed to the action of the swimming feet, and they labour and wriggle more both laterally and vertically, so that, though they can float about for a considerable time, they are much sooner tired when they attempt to swim upon a stretch. These ducks have the tarsi longer, the toes shorter, and the action of the foot in swimming not so much to the rear. The sheldrake is the most landward; but the foot of the common duck is perhaps very nearly the average.

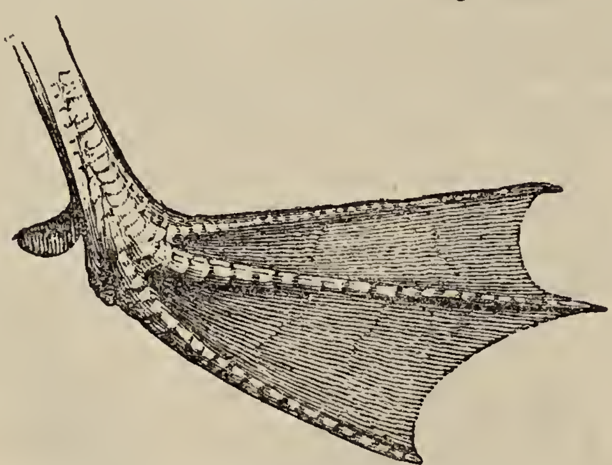


Feet of the swimming and the diving Ducks.

The diving ducks are bad walkers, and seldom upon land; but they are more compact in the build of their bodies than the swimmers. When, however, we speak of swimmers and divers as contrasted with each other, we must bear in mind that there is no definite species with which the one ends or the other begins; for there are species in the middle of the group, partaking in nearly an equal degree of the habits of those at both extremities. The divers have the tarsi short, the tibiæ rather lengthened, which throws the joint of the tarsus backward; the toes and webs larger, and the hind toe with a little web. They do not dive habitually; for though they are less fitted for dabbling than the others, they do practise it a little, and they also feed along the strands; but they often appear to get down for change of motion, as well as for food; and on such occasions they move more quickly below the water than they can on the surface.

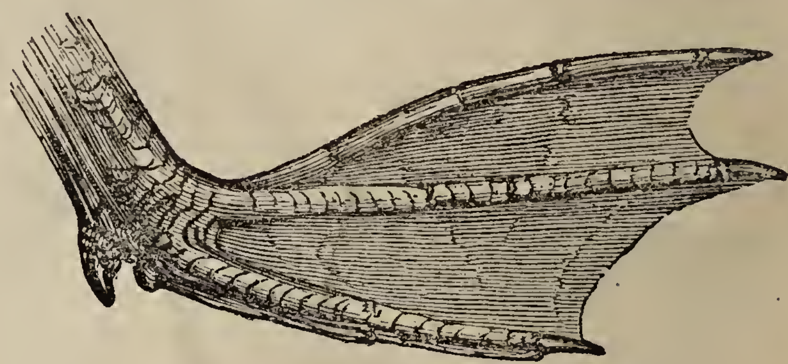
Of course when they are once down, and the water has closed over them, there is no more paddling with the alternate feet. That is properly a land motion, and can be used as the sole means of progression only when part, at least, of the body is in a rarer medium than that against which the foot acts. Thus, when the bird is under, it immediately brings all the four extremities into action, in the same manner as is done by frogs, water-tortoises, and all other animals which have four extremities and swim immersed.

This is the style in which man swims, and also those mammalia which have not a trotting pace between the slow walk and the gallop, the common pig for instance. It is also the style of all aquatic mammalia, and indeed of all vertebrated animals which inhabit the waters; for those which have no fins of any sort cannot advance with one flexure of the body, but must twine in two or more, eel-fashion, according to their length. The golden-eye is the duck, visiting the British shores, which has this action in greatest perfection; and the following is the figure of its foot.



Golden Eye.

But even in the birds last mentioned, progressive motion under water is only an occasional action, and therefore they have it not in the finest style. The grebes which, notwithstanding their merely lobed feet, and their inhabiting ponds rank with vegetation rather than the ocean or even the larger lakes, are much more aquatic than the golden-eye; and the rate at which they get on under water would not be believed by those who have not actually seen it. It is frog-like, to be sure, from the way in which the feet are worked, and the nearness to which the plane of their action approaches to that of the body, but it more resembles the rush of a bird through the air than the swimming of any ordinary air-inhabitant in the water. Among all the diving birds, from the merganser to the penguin, which, although not the swiftest, perhaps, in the water, is the one which depends most exclusively upon aquatic motion, there is not much difference in the feet, so far as can be shown by a figure. The chief distinctions consist in the legs being placed further backward, and the tarsi being shorter and stouter, the more exclusively that the bird is restricted to the motions of swimming and diving. The joints have also more oblique motion, and there appear to be some peculiar muscles upon the tarsus, which assist in the curious twisting motions of the feet, which of course increase as the wings become less efficient as organs of support and balance. But the most curious motions of these birds are all performed in the sea, and under water, so that they are rarely seen, and the subject is one upon which it is by no means safe to speculate, as we have not upon land any analogy to which we can trust. The following is a sketch of one of the feet; but we should not be able to illustrate the mode of action, even if we gave ever so accurate a figure of the bird itself.



Diver.

The feet which have been now described, or rather simply noticed, carry their owners down into the depths of the ocean as far as winged creatures can descend; and as the knowledge of them is nearly as dark and downward as the places of their resort, it is rather pleasant to escape from them, and once more visit the sun and the sky, the cheerer and the abode of the more typical birds.

We have, next in order, to notice those feet which are entirely webbed, that is, which have the hind toe included in the web as well as the three front ones. At first, one would be apt to conclude that these, as being the most webbed, are the most aquatic, or the best swimming feet of the whole. But such is not the case in fact; and when we come to consider the matter a little more closely, we find that such ought not to be the case, according to the structural analogy. The back toe of a bird, whether its path be upon the land or the water, is never an auxiliary to the foot in merely progressive motion; it is always rather the reverse, and placed there in accordance with something else; and thus the produced hind toe, which is rudimental or wanting in all birds which have their motion confined either to the surface of the earth or to the water, indicates an aerial character in this group. Accordingly, the pelicans, cormorants, darters, and several others which have feet of this description, often migrate inland, and perch and also build in trees; and even those which never or rarely quit the sea, build high upon the cliffs, and take their repose upon the land, while some of the swimmers fold their head under their wing and sleep in safety upon the water.

These birds have the feet differently articulated in the different genera; as, for instance, the cormorant has them much farther back than the gannet, and is not able to carry the axis of its body in so horizontal a position. But they all "stand well" on their legs, only the feet, in consequence of that form which is required to answer the habit of the bird in feeding, come rather into contact with each other, and render the walk awkward and swinging. The tarsi are perpendicular or nearly so; but they are thrown wide of each other by the position of the tibiæ; and it is to this wide setting of the tarsi, and not to any want of firmness in the articulation of the toes, that the birds owe their rolling gait when they walk. The foot is nearly a semicircle, or rather a semioctagon of unequal sides, of which the outer toe (which is generally very long) and the back one form the largest diameter. This is articulated upon the tarsus, intermediate between the directions of inward and forward, as may be seen in the annexed cut of the foot of the gannet, which, as one of the most active and best known birds of the group, may be taken as the type, in as far as the foot is concerned.

Gannet.

The birds which have this structure of foot are all fishers, and most of them (the gannets especially) dash down almost perpendicularly from great heights upon their prey, and seize it with the bill. The gannet is curiously provided against any injurious effect from these headlong plunges. On the breast and throat of this bird there are three great air-cells between the integuments and the muscles, the two largest divided (but not shut out) from each other by a perforated septum along the keel of the sternum, and tied to the enveloping membrane of the muscles by a number of small straps of membrane; and the smaller one anterior of the furcal bone, and not communicating with the other two, though all the three have communications with the air-cells in the interior of the bird. When the bird dashes down at a fish, the air in those cells breaks its fall; acts like a parachute in preventing it from going too deep; probably invigorates its vital system by the application of a portion of air, condensed by the resistance and cooling effect of the water, to the coats of the arteries; and, what is more to our present purpose, assists it in recovering its position, in order that it may remount the sky, after it has either caught its prey or failed in doing so. This quantity of air is of course condensed by the collision; but when that is over it expands and raises the anterior part of the body, and at the same time throws the centre of gravity further backwards, or more in a line with the feet. These at the same time press downward with their curious webs, both brought under the body by the position in which the toes are articulated on the tarsi, and so heave the body upward in the same manner, or at least upon the same principle, that ordinary swimming feet impel the body of a bird forward. Thus, what with the action of the air, and what with that of the feet, the bird is able to regain the wing without any difficulty.

When the proper action of the foot is connected with some action of the wings of the bird, as adapting the foot for some particular kind of surface, or to accomplish some other object in the general economy of the creature, it always lessens the perfection of the organ as a foot, whether for swimming or for walking.

Concentration upon one single part, or upon the smallest number of parts possible, is always the structure of maximum action in nature. We find it in the wing of the swift, in the foot of the ostrich, in the feet of all the swifter running birds, and in the more perfect swimmers; for though these have the back toe with a marginal lobe, which appears to answer some purpose in the oblique motions of the foot, just as the bastard wing appears to assist in the oblique motions of the main one, though what the specific motion or assistance which this partially developed part gives in the performance of it, can be found only by a more nice and thorough analysis than has hitherto been applied to the mechanics of animals.

This delightful study is, indeed, as humbling to the pride of human learning as it is gratifying to the spirit of more lowly but more reverential inquiry; and the man who comes to it mailed and cuirassed all over with the forms and the formulæ of the schools, is much in the same predicament as the young Israelite when he put on the armour of the king to combat with the giant Philistine—he is encumbered and oppressed; and if he would hope to conquer, he finds that "the smooth stone from the brook"—that which nature affords to observation, must be the true weapon of his warfare, and all his learning only "the sling," by means of which it is sent to its destination with the requisite force.

And if they who weary their days under the load of the armour, had not their eyes dimmed and dazzled by its glitter, they would see that such must be the case: that natural action—the action of that which has life—must have a way of its own, according to which, and only according to which, it can be studied. In a machine of human contrivance, not only all the parts, and the precise degree in which each part contributes to the compound effect of the whole, can be determined, but the *motive* power can also be estimated with the greatest accuracy, and the whole can be planned, and what it could or could not accomplish known, before there is one peg of it in existence, and though it never should exist.

In the animal structure we can also examine all the parts, and, comparing them with what they do in one case, we can form an appropriate judgment of what they can do in another. We can say, for instance, of the action of a foot in swimming, that it is a "function" of certain bones, and muscles, and tendons, and membranes, and other parts, all of which may be *eliminated* by the knife of the dissector. But we do not thus arrive at the specific action of the foot, either in power or in mode, for that is also a "function" of the energy of life in the animal; and so far from being able to express this energy in terms of any known or measurable quantities, we have no expression at all involving it, but that very compound action, the principles of which we seek thus in vain to analyse.

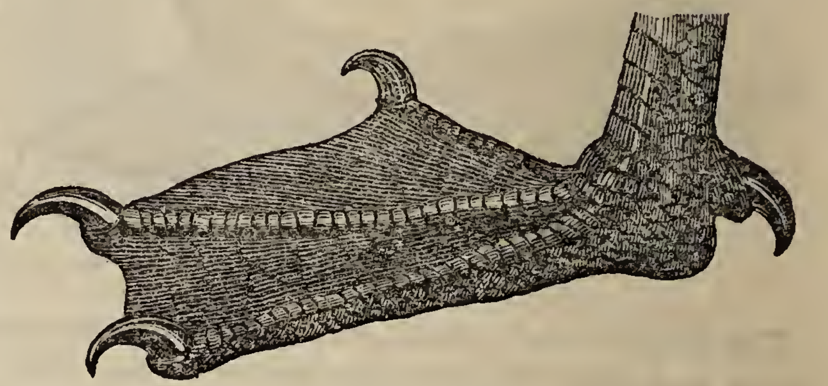
But even this, mortifying as it is to those who labour to appear wise, is fraught with the same advantages and pleasure which are found everywhere in nature. The animal cannot be wholly brought into the closet, so as that the scientific recluse can become fully acquainted with it there, at the sacrifice of much of his health, usefulness, and pleasure. He must go to field and flood, and see the creatures, otherwise he may dream out the years of Methuselah (if the canker of his seclusion shall not eat him up in the twentieth part of that long period), without one moment of awakening to reality and knowledge. Thus, as it were, the coyness of nature is one of her principal fascinations, and he who would secure her favour must woo her as a bride, which, both in the fact and the figure, is the only path in which pleasure and profit are inseparable.

Feet of the Longipennes, or long-winged birds. As the birds of this group all depend more on the wing than the feet for the aquatic part of their food, and as many of them alight on the water chiefly, or exclusively, for the purposes of rest, and not of feeding, they have less of positive character in their feet than the swimming and diving birds, and less even than those birds which, like the gannet, use the feet in working upward to take the wing. These feet are accordingly less stout in the tarsi, and less produced in the toes and webs, and they are without the oblique motions, and have the toes and webs turned nearly in the direction of the front: the outer and inner of nearly the same length, and the middle one little different. The webs, too, are much narrower in proportion to the length of the toes than in the swimming birds, and the hind toe always very short, sometimes a mere tubercle, or a rudimental nail, but differently placed according to the habit.

These birds can all swim, and most of them ride very buoyant on the water, and they sometimes feed as well as rest there; but as their neck is short, and they do not dive, they command a very limited range of the water when they are on its surface. One principal use of their feet is in alighting and rising from the water, which they do more readily than any other birds. They come down with a twitch, halt on the surface, and are on the wing again almost in an instant. In alighting, they advance the feet flat under the body, with the anterior edge of the webs in advance of the centre of gravity; and as the principal joints act parallel to the mesial plane, the least exertion in pushing down the webbed feet, reacting on the centre of gravity, and raising it a little backward as well as upward, throws the bird so clear of the water, that its open wings take the air and it is instantly in the sky. All this is accomplished without occasioning the least splash or disturbance of the water; whereas those birds which feed on or in that element, and use the wing only in journeying from place to place, always make a splash when they alight, and have some trouble before they get on the wing. The length of the tarsus is the principal character of the foot, by which those of different habits may be distinguished. It is, of course, longest in those which walk most on the ground, whether inland or along the beaches, and gradually shorter in proportion as they are more exclusively occupied in skimming over the surface of the sea.

The gulls have it the longest, but it is slender and a portion above the tarsal joint is bare of feathers. Their front toes and webs are of moderate length; but the hind toe is very short, without any web, and articulated higher up than the front ones. The feet are placed considerably forward; and although there is an obliquity of the tibiæ which throws the tarsal joints a little outwards, the birds walk with less of a rolling motion than any of the swimming birds.

The skuas have the feet nearly of the same form; but the hinder toe is a mere tubercle, articulated on the same plane with the front toes. They also have the claws considerably hooked, which agrees with the raven-like habit of the birds, which displays itself in eating carrion, and plundering the nests of birds which build in the banks; and which they have in addition to their peculiar and more characteristic habit of attacking other birds (gulls chiefly) and making them deliver up the contents of their stomachs. The length and crookedness of the claws might lead to the supposition that the skuas, which are very bold birds, use these instruments as hawks do; but such is not the case, though they may assist the birds in holding-on upon oily carcasses which they find floating in the sea, or on land carrion, to which they have no objection, if it comes in their way. Some of them also eat crustaceous animals and shelled mollusca; and they may very naturally be supposed to hold these with the claws while they break or divide them with the strong bill. The annexed is the foot of the common species.

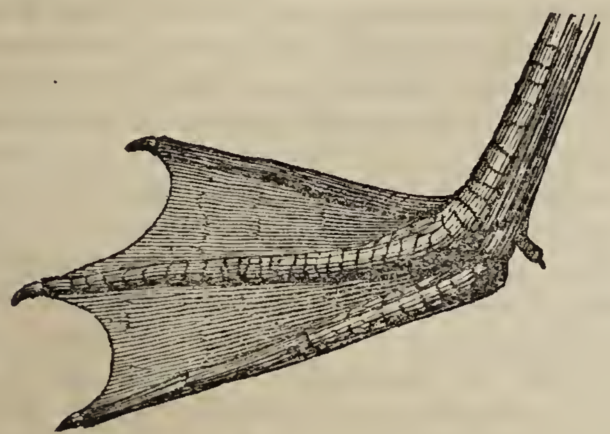


Common Skua.

The terns, which have very much the form of the swallow tribe in the body, the wings, and the tail, and also in style of flight, though the bill and the food are different, have the tarsi shorter, and the feet altogether smaller than any others of the group. They at the same time, however, preserve a certain degree of likeness to the gulls, and, like these, many of them are discovered inland upon the fresh waters.

Terns are the birds most peculiarly adapted for twitching small prey out of the water, which they do with wonderful celerity; and their feet, with very short tarsi, and articulated forwards upon the body, enable them to alight and arise in the swift and easy manner formerly alluded to. Their front toes are all nearly of equal length, their hind toe very small, free, and pointing downwards.

The petrels have the feet with the tarsi considerably longer than those of the terns, and generally compressed in the direction of their action. They have three toes to the front, webbed like those of the terns, and a small claw in place of the hind toe. These feet are, like those of the others, only auxiliary to the principal natural action which is performed by the wings, and they are adapted to a different sort of flight. The terns, though not birds of lofty flight, fly moderately high, and catch those substances upon which they feed by twitching down, snapping with the bill, and instantly rising again. The petrels skim along the surface, and pick up the lighter substances without altering their motion. On these occasions they often, but not always, tip the water with the webs of their feet, to aid the motion of the wings, or sometimes to render it unnecessary. The length and compressed form of the tarsi fit them well for this purpose, while their lightness of structure, in proportion to the strength of the muscles by which they are put in motion, enables them to move with great celerity, and yet occasion little fatigue. At the same time, the action of tipping is done in so clean a style, that the water is not disturbed, and the motion of the legs is not seen unless when the observer is very close to the bird. Some of the larger species, which are found on the Antartic ocean, are nearly of the same dimensions as a wild goose, and yet they will let themselves down, with the wings fully expanded, till the points of their webs touch the surface of the water, and then they will glide along without a movement of the wing till they are lost in the distance. The cut represents the foot of the fulmar petrel, which is very common on the seas to the northward of the British islands.



Fulmar.

Such are a few of the leading distinctions in the feet of birds, whether those feet are in themselves the principal organs of motion, or whether they are made use of as auxiliary to other organs; but the parts of a bird act so much in concert, that no one of them can be fully understood without a knowledge of the others.

VII. Wings of Birds.—As wings are the grand characteristic of birds—that which more especially distinguishes them as a class from all other vertebrated animals, one might naturally suppose that in these organs would be found not only the best means of subdividing them into orders, groups, and genera, but also the best indications of the habits of even particular species. De Blainville was, we believe, the first to suggest such an arrangement ; and an outline was subsequently given by Dr. Lherminier, in the Transactions of the Linnæan Society of Paris, and afterwards in a separate pamphlet, in the year 1828.

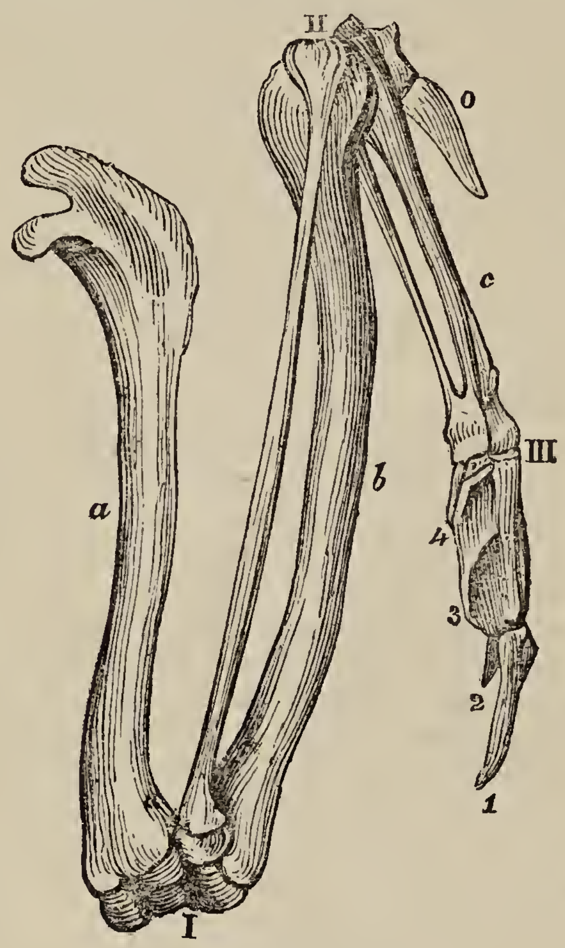
There is a great deal of merit in M. Lherminier's little work, the size and science of which are well worthy the attention of all writers upon similar subjects. But still, though a system could unquestionably be founded upon the wings of birds, or even, as the Doctor's is, founded upon the sternal apparatus in the skeleton, as giving insertion and stability to those muscles which perform the grand motions of the wing ; yet that, after all, would be a system of flying, and not a system of birds, because all birds must eat ; and there are no birds so absolutely destitute of feet as some birds are of wings. Notwithstanding, the wings, and especially this part of them, and not merely the numbers, lengths, and arrangements of the flying feathers, which are almost the only characters usually noticed even by those who profess to write scientifically upon this class of animals, are highly important toward the formation of such a systematic arrangement as shall be of use—that is, which shall direct and shorten the labour of the student who seeks for a knowledge of the characters and uses of these highly interesting creatures.

The mass of the body in birds is, from the inflexibility of the spine, what may be called passive, or rather consenting, in those actions wherein the characters of birds are displayed, as it does not directly perform any of those external operations which are open to observation, though there is no doubt that it is always of that form which gives greatest facility to the more active part of the animal, whether that part be bill, or foot, or wing. To enter minutely into the anatomical structure of a wing, so as to make all its parts intelligible to common readers, would require far more space, and more illustration, than are compatible with the nature and design of this work ; and without a perfect knowledge of the parts, it would of course be impossible to give any idea of their individual action. Then, as to the joint-action of the whole, that is a matter which cannot be expressed. There are twelve distinct moving forces all acting, in one way or other, upon the first, or shoulder-joint of the wing. Those forces are all different in what may be called their structural energy—in the power they derive from their manner of application—in their effect in different positions of the wing—and in their energy from different degrees of excitement in the bird ; so that, when we take those causes of difference, and consider them in all the combinations and changes of which they are susceptible, we are within the truth when we say, that, counting from morning to night every day for a thousand years, would be insufficient simply to enumerate all the motions and positions of which even this joint of one wing of a single bird is susceptible.

Still, in order to be able to observe birds with advantage, as they appear to us in every-day nature, so as to turn them to those purposes of instruction and companionship to which they can so easily and pleasantly be turned, it is necessary to have some general notion of the parts of a wing. These parts, considering them simply according to the substances of which they are composed, are, first, feathers, which being palpable to the eye without much, or even any separation of parts, may be ranked among the mere external appearances, as noticed in a former section; secondly, the substance of the solid wing which is made up : these are the bones and muscles, of which some notice has also been taken, but it may be necessary very briefly to revert to them.

The jer-falcon, to which we have already alluded as the most typical of birds in their general character as flyers, may be again advantageously used as a model, and the figure of the bones of its wing examined in comparison with the corresponding portions of the human arm. The figure on the next page represents the bones of the right wing in half the lineal dimensions of nature.

The position is nearly that of the closed wing ; and it can be understood by bringing the elbow against the side, the wrist to the shoulder, and bending down the hand on the fore-arm. The portion marked *a* answers to the humeral part of the human arm, that is, from the shoulder to the elbow, and consists of a single bone, the humerus. The portion marked *b* answers to the fore-arm, or cubit, the part of the arm from the elbow to the wrist. This part consists of two bones, a larger and curved one, the radius, and a more slender and straighter one, the ulna. The portion marked *c* answers to the hand in man ; *o* is the thumb, which in the bird carries the bastard wing ; in this wing it is tolerably developed, and consists of two phalanges of bone soldered together, the union of which may be seen at *o*. The metacarpal bones, answering to the palm of the hand, extend from II, the wrist joint, to III, the knuckle joint ; and this also consists of two portions, extending the whole length, and united at both extremities. From the knuckle joint at III to the point at 1, answers to the fingers in the human hand. The fore-finger, from III to 1, consists of two phalanges soldered together. The distal phalanx forms the tip of the wing, and terminates at 1. This phalanx consists of only a single bone. This bone consists of a longer thickened portion, the fore-finger ending at 1, and a shorter, the second finger, ending at 2, with a thinner portion of bone between them. The second phalanx, which is broad and flat, is marked by oblique thickened portions ending at 3 and 4, and answering to the third and fourth fingers, only the whole is one plate of bone, thickened and strengthened by the oblique ridges terminating at 3 and 4, which proceed from a thickened portion continued along the other side.



Jer-falcon's wing.

It will be seen that all the bones in this wing which have moveable joints are very much enlarged at their extremities; and that, with the exception of the joint at the head of the humerus, one part only of which is seen, as the socket in which the shoulder joint moves is not shown in the figure, have their motions chiefly in one direction or plane only.

When the wing is extended, the upper process of the head of the humerus is brought considerably within the centre of motion of the shoulder-joint. To it the tendons of the muscles which raise the wing are attached, and its projection, increased beyond the centre of motion, gives the lever power, by means of which these muscles act. The muscle which depresses the wing, or gives the stroke in flying, has its tendon attached to the under side of the flattened portion of the head of the humeral bone, farther without the centre of motion than the others are within it, and therefore it acts upon a longer lever of power, and has a shorter lever of resistance to overcome than the muscles which elevate the wing.

All the round bones of the wing are hollow, or tubular, which makes them much lighter than if they had been solid and of the same dimensions, and much stronger and stiffer than if they were solid with the same quantity of bone. But at all places where there is either a muscle or a tendon inserted, the action of which would be upon one side only of the tube, there is a tie, or septum of bone extending from the one side to the other, so that it may throw the strain equally upon both sides of the tube. If this strain is great, these ties are branched, so that they throw it upon a considerable portion of the bone, and as they are ties in the one direction and struts in the cross one, and all gradually run into the bone by heads enlarging in curves, they give the same strength as if the bone were entirely solid throughout. Indeed, for maximum of strength and stiffness, with minimum of weight, these bones are quite a study.

The elbow joint, I, is very beautifully constructed. It is a sort of triple hinge; and when the humerus and radius are brought into the same line in the stretching of the wing, the processes, as may be seen from their form, stop it from having the least flexure in the other direction, while the head of the ulna comes over the centre, between the double processes of the two principal bones, and wedges it against all bending upwards, something in the same manner as the keystone of an arch.

The wrist-joint at II, is also both very peculiar and very firm. It admits of extension till the metacarpal bones (the whole hand in fact) be nearly in the same line with the fore-arm, but beyond this it cannot be stretched without breaking the wing; and here the other end of the ulna, together with the bones of the thumb, offer the same resistance against bending in the wrong direction that is offered by the elbow-joint.

The knuckle-joint, III, has little or no motion in any direction; and it rather gives a little elasticity to the bone, which is very hard and firm in its texture, than answers any other purpose; but, though very light, that portion of the wing is, from the way in which the thickened parts are placed, actually stronger in rapid motion than if it were all as thick as those.

The form of all the bones, indeed, is such as to give them the maximum both of stiffness and of strength. The humerus, which is the only single bone, is very strong, both from its shape and from the cross pieces inside the tube opposite to the insertions of the muscles and tendons; and even these are additional means of support. This bone, too, is so near the centre of motion, that the resistance of the air acts much less powerfully upon it than upon the others. The fore-arm, having to sustain the broadest part of the wing, is very strong: indeed it is the strongest form which, combined with the same lightness, could be given; and lightness is as essential as firmness in all the parts of a wing, because weight would be a source both of weakness and fatigue. The radius, or larger bone, has the form of a bow, and the smaller one, the ulna, that of a bow-string; and any one who places the tips or horns of a bent bow on the ground, and tries to crush it by pressing down the middle of the bend, will find it much stiffer and stronger than a straight stick of twice the thickness. A very portable bridge is often made upon this principle, of a thin plank, bent into the form of a bow by a cord tied to the two ends; and when tied in this manner, a plank which a man can carry without fatigue, will enable him to cross with safety a chasm ten or twelve feet wide.

But the bow and the bridge are very imperfect pieces of mechanism, as compared with this portion of the wing. They are strong in one direction only; that is, when the strain or pressure is upon the outside of the bend, and this is in them the position of least stability. If its position is reversed, the bow bridge is weaker than a straight plank by the whole extent to which it is bent, as the string offers no resistance to further bending. But it will be seen, on looking back at the figure, that the radius, which answers to the bow, is one of very curious curvature. Though less in diameter at the middle than toward the ends, it has its stiffness there greatly increased by being not only straight, but a very little bent the other way. This against a single strain would give it the same strength as a bow has by being thicker, and consequently bending less toward the middle than toward the ends. But the bone has to bear strains and twists in all directions; and therefore, though the double curvature cannot be shown in a figure, it will be found, upon examination of the bone itself, that some part of it is a bow in what direction soever it is turned. The ulna is also both a tie and a strut, and resists equally the drawing asunder and the pressing together of the ends of the larger bone. It is nearly straight, which is the form of greatest strength against both of these; and it is spindle-shaped, or thickened toward the middle of its length, which is the form of greatest stiffness. But we must not proceed much farther in the consideration of this exquisite piece of mechanism:—it would not only afford study for years, but remain in great part an unexplained wonder after we had exercised the longest life upon it.

But, admirable as is the structure of this moving part of the wing, it would fail in producing its office if the point to which it is attached, and the organs by which it is moved, did not partake of the same character: for without this it would be like a well-made tool or a powerful weapon placed in an unskilful hand.

The sternum is the grand bone upon which the articulation of the wing at the shoulder-joint, and the muscles which move that joint, are founded; and therefore, the general power of every wing may be judged of more from that bone than from any other single part.

But, in order to have a clear understanding of the relative power of wings, it is necessary to examine carefully all the bones which support the point to which the wing is articulated, or which afford insertion to the muscles by which it is moved. It has been already mentioned, in the general notice of the structure of birds, that the three bones which support that point are the coracoid, the scapula, and the branch of the furcal. The articulation is more immediately upon the coracoid, though the shallow socket in which the head of the humerus plays, is often in part formed by the scapula, with the arm of the furcal bones against the other two on the inside, beyond the socket, and as far as their extremities; and immediately behind the head of the coracoid, to the outside of which the scapula is applied, there is a foramen or hole, which serves as a pulley, through which the tendons of the muscles that raise the wing pass. The firmness with which these three bones are united to each other is always in proportion to the power of flight in the bird. In no bird of powerful wing can any of them be dislocated from the other two without fracture; and in old eagles and hawks, the portion of cartilaginous matter by which they are united passes so completely into bone, though bone which remains a little flexible, that they cannot be detached from each other by maceration in water.

It is worthy of remark, as affording a beautiful instance of that provision of nature by means of which the vital parts of animals are always protected from injury even in their most violent actions, if those actions are natural, or essential to the accomplishment of those purposes which their Creator has ordained them to accomplish, that the anterior extremities of no vertebrated animal are articulated upon the spinal column. This is very remarkably the case in birds of very powerful wing.

In mammalia, the articulation of the humerus is always upon the scapula only; they want the coracoid bones entirely, and in bears, and other species which grasp or hug between the fore legs, the clavicles are wanting. Even in those species, as in the quadrumana, which have the clavicles most perfectly developed, the office of these bones is secondary, chiefly that of keeping the shoulder-joints apart from each other, so that the animals may stretch their fore-legs, or arms, at right angles to the mesial plane of the body, and not use them parallel to that plane only, as is the case with those mammalia which employ the fore legs only in walking.

In the mammalia, the scapular bone is flattened and extended to the shape of a triangular plate, and it is furnished with a septum, or elevated keel of bone, to each side of which there are muscles attached, which move the bone backwards or forwards, according as is necessary to the action of the other parts of the limb. But in birds the scapula is never furnished with a ridge or keel of this description; and it is most developed and enlarged at the end farthest from the joint in those birds which make the nearest approach to the quadruped action of the mammalia,—as for instance, in the grebes, which use the wings and the feet, with nearly equal energy, as they make their way under water. In those land-birds, such as the ostrich, which cannot raise the wings, but use them only for balancing the body as they run, the scapulæ are less developed; but even in them, they are more so than in the birds of the most powerful flight. These birds have not the clavicles united in front into a regular arch, as in powerfully-winged birds, or even into a fork with the branches nearly straight, as in the gallinidæ and other bad fliers; and in some of the species they are little else than mere processes on the anterior edges of the coracoid bones.

In no case, however, of these short-winged birds are the coracoid bones, which connect the scapulars with the anterior part of the sternum, wanting: and in no case, even of those of most vigorous flight, in which the furcal bone is the most developed, are the humeral bones of the wings articulated directly upon that bone.

It is here, that we find one of those strikingly distinctive characters from which we can at once pronounce a bird to be a bird, whether it has or has not the power of flight; and here, that we are enabled to see which is the characteristic bone in this part of the skeleton which is possessed by birds and never by mammalia. On this point it would be unjust not to acknowledge the merit due to the science and the sagacity of Cuvier. Before his time, those who treated of the structures of animals, and of the structural differences of the several classes of vertebrated ones, were somewhat at a loss which to consider as the additional bone in birds, and which as the true clavicle; and the furcal bone, as being the most anterior one, and the least connected with the sternum, was generally considered as the additional one, and the coracoid bones, which have nearly the same relative position with regard to the sternum, as the clavicles of mammalia, as the true clavicles of birds.

But when we examine, with due attention, the skeletons of all birds, whether capable or not capable of flight, and if capable, whether they fly with more or less power, we find that the coracoid is the true distinguishing bone of the winged race—the bone which connects the anterior extremities with the sternum as their grand support; and that the furcal bone is more or less perfect, or present, or wanting, according to the difference of habit, as in the mammalia—we must admit, with the illustrious author of the *Regne Animale*, that that bone is really the clavicle; and that the coracoid bone is just as essential to the existence of a bird as the scapular bone is to that of the mammalia. The humerus of the wing in birds is as constantly articulated (that is, *chiefly* articulated) upon the coracoid as the fore leg of the mammalia is articulated upon the shoulder-bone, or blade-bone; and the furcal bone is present in the one class when the joints of the shoulders require to be kept asunder, and absent when they do not, just as it is in the other.

Thus, in birds, we have the wing as uniformly referred to the sternum, by means of the coracoid, as we have the fore-leg referred to the muscles of the shoulder and the spinous processes by which they are supported in the mammalia; and though both are so placed that neither the one nor the other directly disturbs the vertebral column, so as to derange its important contents, yet they are very beautifully arranged so as to suit the different systematic habits of the animals. In the mammalia, an action of the thorax in heaving and falling is required, in order to carry on the process of breathing by means of lungs and a moveable diaphragm exclusively; and therefore neither the weight of the anterior part of the body, nor the motion of the fore-legs, could be, in them, supported from the sternum, without confining and disturbing that action. Thus the mammalia, when they bear the weight on the fore-legs, have the thorax free as it were, and suspended upon these fore-legs as props, the muscles and other soft parts, which attach the scapular bone to the body, affording an elastic support, similar but superior to that of the springs upon which the body of a carriage is hung.

Birds, on the contrary, never have any support, except by the feet, upon substances which are not in themselves elastic, as the air or the water, and thus the anterior part of their bodies is carried on the sternum, as a basket or boat, that bone being always more produced and developed in proportion as the weight of the body is borne more upon it. If the bearing is chiefly upon the wing, then the strength of the sternum is concentrated forwards; but if upon the under surface of the body, as in the swimming birds, then the sternum is produced backwards, or has more of a boat shape. In birds that fly little, the sternum is weak; and in those which cannot fly it is short, that it may be out of the way of the more vigorous action of the legs which is required in them. In both, and more especially in the latter, it serves more as a breast-plate or buckler for supporting the anterior part of the body, by reference to the spinal column, and by means of that to the legs, than as the ultimate fulcrum of every sort of motion; and in these birds the scapular bones, by means of which the anterior part of the sternum is supported, or rather by means of which it is suspended, are more produced, and have their forms better adapted for a firm imbedment among the muscles of the back, than in habitual flyers. So marked does this character become, that in the ostrich tribe, which, as they do not require the furcal bone to keep the heads of the scapulars asunder have it only in two rudimental processes, the coracoids and scapulars have much the character and office of two hooks, which, taking hold by means of their imbedment in the flesh, bear up the anterior part of the sternum.

This enlarged and basket or boat-shaped sternum, together with the coracoid bones, are therefore to be regarded as the most typical part not only of the skeleton of birds, but of their whole organisation. The form of the sternum varies much with the habits of the different species; but it is, in all cases, the characteristic sternum of a bird, and in no species, which has been examined, has it been found without coracoids, though in those species where these do little else than suspend the sternum they are united into nearly one continued flat piece with the scapulars.

It is to be regretted that, hitherto, there has been no opportunity of completing this part of the series by examining the sternal apparatus of the apteryx, which, as the most wingless of the class, and as being, from the structure of its feet, a bird of slow motion, must be the one which has the sternal apparatus most exclusively formed for the support of the anterior part of the body only. Thus in it we should have a real analysis of this most characteristic part of the structure of birds, not by mere dissection, where we are left to guess at the use of the organ from its form and its connexion with other organs, but actually in the living bird. By this means we should be able to separate the two functions of the sternal apparatus—the simple and more general, which supports the body of the animal, and the more complicated and variable, which relates to the operation of flying.

Sterna of Wingless Birds.—Wingless, though the epithet commonly given to those birds that are incapable of flight, is by no means an accurate one. There is no bird absolutely wingless, even though it should have the bones of the wing wholly within the integuments. When we reflect a little on the matter, we find that such might be expected. A wing is an organ of flight, and the performing of that operation is the chief apparent use of the wing. But the wing is also, independently of its action in flying, an integrant part of the structure of a bird—a part which the bird has, whether it be in motion or at rest. Now, it should always be borne in mind, that an animal is a perfect structure, and that all its parts are in concert, whether it be in a state of action or in a state of repose. One part does not, therefore, merely press up, or move the other, as in the case of our structures and machines. In our moving structures we have to apply some *external power* to put the structure in motion, after all its parts are completed; but the motive force of the animal is *internal*, and we cannot locate it to one part of the organisation. The animal has, therefore, the whole of its structure *consenting*, and not merely consenting, but *co-operating* in all its actions and all its positions of repose; and it should seem that the shoulder-joint of a bird is incapable even of supporting the sternum, and with that the under part of the body, so as to make the horizontal spine stable upon two legs without the addition of a rudimental wing. Thus there is a harmony and reciprocal action in the parts of the bird, so that while the one assists the other in its operations, it receives assistance in return: as in this instance, the shoulder-joint supports the wing, and the articulation of the wing is necessary to the perfection of the shoulder-joint. This mutual or reciprocal assistance of the parts of an animal to each other is one of the more remarkable points of difference between the mechanics of the living body and of dead matter, and it is one of which we should never lose sight, when we speculate about the former.

We have no practical knowledge of a bird with a perfectly immoveable wing, but we have a very near approximation in the emu, which, although a long-legged and swift-footed bird, has its covering, and probably also its food, much more analogous to that of the apteryx than the true ostriches have; and it is curious also that the two, the one in Australia and the other in New Zealand, are more nearly neighbours, and inhabit climates which are much more nearly similar than those inhabited by the others. On this account we shall, before proceeding to take a very short glance at the comparative structures of the sterna of some of the more remarkable flying birds with reference to their forms of flight, notice that of the emu, as being nearly confined to the supporting of the anterior part of the body.

This sternum is oval, without any keel, and bears some resemblance to the breast-plate of a tortoise; and the coracoids, whose principal use is to support the bone, and preserve the form of the anterior part of the chest against the weight of the bird, the presence of the atmosphere, and casualties, without having any direct strain to bear when the bird is in motion, are short, broad, and flat.

The following figure is a side view of this sternal apparatus.

Emu.

The outline of the sternum of this bird is, it will be seen, very convex, with merely a trace of a keel at the anterior part, near the junction of the coracoids. The ribs are articulated far forward, and they are much thicker and stronger than in flying birds. There is not, upon this bony structure, any place where muscles capable of giving motion to a wing could be inserted. The strong articulation by the coracoids and the ribs, and the length of the scapulars which suspend the former, enable this form of bone, however, to give the most efficient support to the body, as a basket in which the thoracic viscera are carried; and its convex form renders it a most efficient breast-plate against any external injury to which the bird may be exposed.

Those who consider flight as the essential characteristic of birds, sometimes regard this structure as an imperfect one; but when we examine it with regard to the offices which it has to perform, we find the same perfection of adaptation in it as in that form which affords a fulcrum to the most active wing, and insertion to the most powerful muscles. The species of land birds incapable of flight are so few, and their natural pastures on the earth so peculiar and so limited, that we can with difficulty so connect them with the rest of nature as to understand the part which they act in the general economy. But though they are thus, in a great measure, a sealed book to us, we find that, in as far as we can study them with relation to their haunts, they afford as irresistible evidence of that perfect knowledge of all the circumstances, at the original formation of the creature, which inscribes the name of God upon all that God has made, in characters so plain that he who runs may read, as any other race that can be named. The ostrich on the arid expanse of the African karoo, the nhandu among the tall herbage of the American pampas, the emu on the "hummocky" plains of Australia, and (as we have reason to suppose) the apteryx by the shingly bases of the New Zealand cliffs, are all as much in harmony with the scenes in which we find them, as the parrot is with the perennial bloom of the tropical forest, or the albatross or the petrel is with the expanse of the world of waters. Wings are not wanted upon extended flats of firm surface; they are for the "ups and downs" of feeding grounds; and, therefore, those birds to which wings would be an incumbrance have them not, but in their stead organisations better suited to their haunts.

Sterna of winged Birds. In considering the sterna of birds as indices to their different powers of flight, the elevated crest or keel is certainly the most important; while of the other bones which form part of the sternal apparatus, the most important is the clavicle, for as we have seen the coracoid bones are constant, not very much dependent on the rate or style of flight, and the scapulars, though of weaker structure, and less fitted for bearing cross strains, are often more developed in birds which fly heavily than in those which fly well.

But still the form and consistency of the sternal bone itself, independently of its ridge or its appendages, vary considerably in birds of different powers of wing. The firmer the sternum is, that is, the more completely that it consists of one plate of bone, without apertures, and with the different pieces in which ossification begins in the young birds, united by bone, the bird flies the better and the more powerfully; and of course, in proportion as the sternum is deficient in those qualities, the flight of the bird is less elevated and less capable of being continued. If the sternum, besides being of solid bone, is of considerable breadth, and curved in its section as well as in the principal line of its crest, the bird is one of the most powerful wing, and whether its chief exercise be in long flight, or very rapid flight of shorter continuance, depends a good deal on the number, form, and arrangement of the feathers. Generally speaking, however, birds which do not require the violent rush of the accipitres, have the sternum straighter and narrower, though a little longer in proportion. Sterna which are very broad, with the crest low, always indicate bad fliers. Here, however, the adaptation of the sternum for flight, begins to be combined with that for swimming; and, as those two habits occur in many proportions with regard to each other, it is not very easy to frame such a general description of the bone as will apply to all or even half the varieties. When birds of this description come to have the two motions of the wings, the flying one in the air, and the swimming one under water, the form of the external part of the wing is adapted to the one or the other, according to the habit, while the form of the sternum itself remains nearly the same.

Sternal muscles. In order that the action of wings, and the influence which the different modifications of the sternal bones have in that action, may be more clearly understood, it is necessary to say a little more respecting the muscles by which the wings are moved than the mere enumeration which was given in a former section. This may have somewhat the appearance of repetition; but, in treating of complex structures, so much of repetition as shall keep the several parts constantly in the reader's view is not only excusable but necessary; and when the object is to communicate information, that is not the very best taste which sacrifices perspicuity to mere nicety, and plainness of expression to what is (often very falsely) considered elegance of style.

The first set of muscles are those which have their insertion in the sternum, the coracoid bone, and the clavicle, and their tendons attached to the humerus; and these are the muscles which perform the grand operation of working the wing. They are four in number.

The first, the great pectoral muscle, is situated externally toward the anterior part of the sternum, where it has the freest action. It is inserted on the keel and body of the sternum, on the side of the coracoid, and also on that of the clavicle; and its tendon, which is particularly strong and firmly united by a large extent of surface, is attached to the extended crest of the humerus on the lower side. When this muscle contracts, it bends down the humerus on the shoulder-joint; but as it is inserted in all the bones by which that joint is supported, the very same action which bends down the humerus on the joint, tends to push the joint upwards, which not only renders the effect of the pulling of the tendon more steady, but actually increases its force. This is the grand muscle in flying, and it is impossible to imagine an organ better situated or altogether better adapted for its purpose than it is in birds of powerful flight.

Immediately under this there is situated the middle pectoral muscle, which is the antagonist of the former. This muscle lies in the angle formed by the keel and body of the sternum, and is attached also to the coracoid, and partly to the clavicle on the angle of its inner side. It passes under the coracoid, and the tendon in which it terminates, passes through a hole which is formed by the uniting of the coracoid, the clavicle, and the scapular, and returning outwards, is attached, by an extended termination, on the upper side of the crest of the humerus, rather inward of the centre of motion of the shoulder-joint. This is the principal muscle employed in raising the wing; and the mode of its action is a little curious. Its insertion is nearly the same as that of its antagonist, the great pectoral muscle; and when it acts, it tends to raise and keep steady the centre of motion in the shoulder-joint, just as that does; but as its tendon passes through the pulley, or foramen, above-mentioned, its power to produce motion is reversed, and though similarly inserted, and as a muscle acting in the very same way, it produces exactly the opposite effect upon the humerus. The tendon which passes through the pulley is, in many birds, in great part ossified, so that, besides having additional firmness from that structure, the upper part of it acts as a more powerful lever in the raising of the wing.

The action of these two muscles, which are the most important ones in the operation of flying, is one of the most beautiful in the whole range of animal mechanics, wide and varied as it is. The great pectoral which, by depressing the wing, gives the stroke, and therefore performs the most essential operation in flying, is the most free in its action, as it is pressed by the integuments only. It also pulls the wing downwards with the greatest advantage, as its tendon goes directly to the lower part of the humerus without the joint. Its antagonist, which raises the wing, does it by the reversed action of the tendon passing through the pulley; but it acts more rapidly, and it has the same tendency to support the centre of motion as the other: and though there must be some of the power lost by the reversing of the tendon, that is more than compensated by the steadiness given to the joint, and the increased rapidity of the upward motion. That motion is also greatly facilitated by the structure of the feathered part of the wing, which is so formed that while it takes the greatest hold possible on the air when striking downwards, takes the least possible in rising upwards.

Immediately above the mean pectoral muscle, there is a third and much smaller one, which is most conspicuous in those birds which get suddenly on the wing from the ground. Its tendon also passes through the pulley, and is attached to the upper part of the head of the humerus. Its office is to assist the middle pectoral in raising the wing.

The fourth and last of this group is the small pectoral muscle, which is inserted on the sternum to the rear of the others, and also partially to the upper and exterior edge of the coracoid. Its tendon is attached to a tubercle on the lower part of the head of the humerus, and its office is two-fold,—when the muscles which are more immediately employed in moving the wing during flight, are not in action, this muscle draws the humeral part of the wing toward the body by a peculiar twist of the shoulder-joint; and when they are in action, it exerts a sort of twisting influence, by means of which the posterior edge of the wing is prevented from turning upwards, and a sort of rotatory motion is produced, which has considerable influence in the ascent or descent of the bird, and also in the altering of its course while on the wing.

The articulation of the wing with the coracoid is a very peculiar form of joint. It is not a hinge joint, neither is it a ball and socket, but something intermediate between the two, and partaking of the properties of both. The average line, or axis, of its motion is oblique, elevated to the front, and depressed to the rear, but both the principal head of the humerus and the socket have their outlines curved, so that the wing may be advanced or drawn backward at the same time that it is elevated or depressed, and by some of the muscles acting more and some less, all the motions of the shoulder-joint, which are requisite both for the action of flight and the direction of that action, are performed. The double head of the humerus, which may be understood by looking back to the wing of the jer-falcon, or forward to the sternal portion of the skeleton of the golden eagle, assists very materially in both the direct and the oblique motions of this joint. In proportion as the action of the wing is more powerful, the crest of the humerus, that is, the process or portion of the head which is toward the convex side of the bone, or that which is most in advance when the bone is in its natural position, is more produced. It is more so in the humerus of the jer-falcon than perhaps in that of any other bird, and more so in the falcons which prey on the wing than in any other genus of birds.

The second set of muscles in the wing are those which are inserted on the coracoid, and attached to the humerus and the radius. There are two of them attached by a common tendon to the external part of the extremity of the coracoid, near the glenoid cavity, but below it. The coraco-branchial is attached to the crest of the humerus, and acts as the antagonist of the third pectoral, and extends the humerus from the body. The biceps is attached to the radius, and extends the fore-arm or great medial portion of the wing.

There is only one single muscle inserted in both the shoulder-bone and the coracoid. It has its insertion in the lower side of the shoulder bone and the upper edge of the coracoid, and its tendon is inserted in the head of the humerus, on the lower side, by the edge of the insertion of the smaller pectoral muscle. Its office is to close the wing toward the body, but it of course acts only on the humeral portion.

The next set of muscles are those which are attached to the scapula or shoulder-bone only, and act between that bone and either the humeral or the radial portion of the wing. They are three in number. The first is attached to a greater or smaller portion of the external edge of the scapular bone, sometimes in two separate fasciculi of fibres, and sometimes with the two fasciculi united by a tendinous septum. When the latter is the case, it is inserted by one tendon in the posterior edge of the humerus, below the cavity; and in the former, by a tendon and a fasciculus of muscular fibres to nearly the same point. The use of this muscle is to draw the humerus toward the body of the bird, and at the same time to raise it upwards. The second of these muscles is inserted by a very strong tendon to the glenoid cavity, and it is attached to the humerus. Its office is to draw the wing toward the body, and raise it, and also to extend the fore-arm, or radial joint of the wing. The third of these muscles is a long and slender fasciculus, which, originating in the lower and exterior part of the scapular bone, behind the last-mentioned one, is attached to the scapula, and appears chiefly an auxiliary to the former.

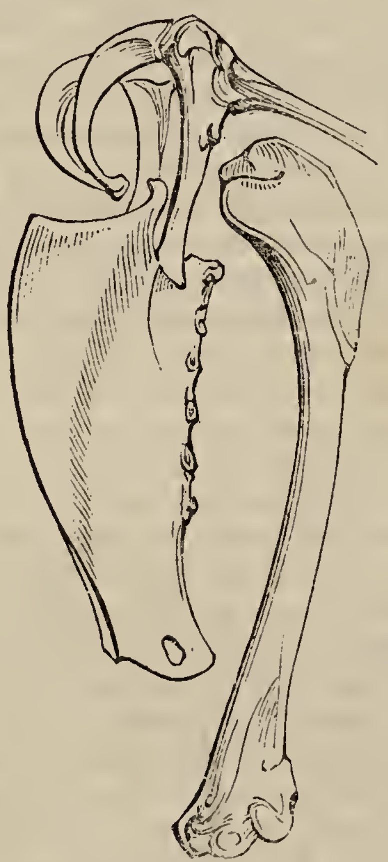
There are two muscles originating in the scapula, the clavicle and the coracoid, which chiefly assist in elevating the wing, or in advancing it, or bending it to the rear, when the bird is in flight. But the actions of these secondary muscles, which are efficient chiefly in altering the direction of the birds in flight, upward, downward, or laterally, cannot be fully explained without more space, and more illustrative figures, than are compatible with the nature, and indeed the purpose, of this brief sketch. The whole of the muscular actions of a wing form a very extensive as well as a very nice subject for study, and one which can be very imperfectly comprehended even by those who devote their whole time and their best attention to it. The reason is obvious: the actions of the numerous muscles of the wing are so combined with each other, and the action of the one modifies that of the other so much, that the most minute definition, and the most careful study, are incapable of informing us how the wing acts in all its varied motions; so that the utmost which, in the present state of science, we can expect to obtain, is a very rude and imperfect estimate of the relative powers of wings, derived fully as much from what we see them performing in the living bird, as from any thing apparently more scientific (and it is mere appearance rather than reality) which we find in dissecting the dead one.

In giving a few examples of the form of the sternum, and its apparatus, the coracoids, the clavicle, and the scapulars, as illustrative of the power of flight in birds, we shall not attempt to follow even the outline of a system proposed by M. Lherminier, because that is incomplete, as treating of the sternal apparatus with reference to flight only, and not combining the general character of the class, the support which the body receives from the sternal bones, altogether independent of power of flight; and also because, though very ingenious and scientific so far as it goes, the sketch which he gives is not perfectly satisfactory, even in so far as the mere action of flying is concerned. The sternum and the sternal apparatus, whether of bones or of muscles, are not the whole organs of flight, we have still to take into account the bones and muscles of the wing, and the character of the feathers with which that wing is furnished; and even if we were put fully in possession of these, there still remains the accordance of the other structures of the bird with the entire wing, as relates to the style of flight, and also to those other actions of the bird with which the flight is always in accordance. In consequence of these difficulties, which volumes of writing would not explain away, we must content ourselves with a few short notices of the sternal apparatus of the leading division of birds, as formed on the usual mixed characters.

Sterna of the Accipitres. This is firm, though the thicker parts of it are full of air-cells, more especially the enlarged base of the keel, which passes, by a gradual curvature, into the surface of the sides of the sternum, without any corresponding cavity on the upper side, or side toward the interior of the bird. Its form is nearly that of a parallelogram, with the length exceeding the breadth, concave on the upper side, and convex on the under. The keel generally large and elevated, but always lower the broader the sternum is in proportion to its length. The anterior margin of the keel is concave, and the under one convex: the anterior angle sometimes even with the anterior part of the bone, and sometimes in advance of it, with the edge thickened, as if it consisted of two pieces united together; the keel much higher at the place where the great pectoral muscle is inserted than at the insertion of the middle one. The sides are a little concave, and the ribs vary from five to seven; the posterior edge generally nearly straight, with a lateral hole in each angle, but these are often nearly, and sometimes wholly, obliterated by bone. There is not, even in the youngest stage of the more typical birds, any appearance of distinct bones forming the sternum, as there are in birds of some other orders, but the process of ossification begins at the fore-part, and proceeds regularly backwards.

The coraeoids are shorter than the sternum, but very strongly formed, and their internal angles, where they are attached to the sternum, often meet each other. The clavicles form a complete arch, more or less depressed toward the centre, having its depth placed in the direction of the strain; of nearly equal strength throughout its length in the falcons, which are the birds of most rapid and continuous flight, but diminished toward the middle in most of the others; and firmly united at both extremities to the scapulars and the coracoids.

The scapulars are a little longer than the sides of the sternum, oval in their section, slightly curved, pointed at their extremities, and firmly united with the coracoids and clavicle at the angle of the shoulder, a little above the articulation of the humerus, to which they afford a very firm point of support, and to the tendon of whose elevating muscle they furnish a very perfect pulley.



Golden Eagle.

We have given in the above cut a profile of the sternum of the golden eagle, as about the average of the order, and we add the humerus, to show the relative size of that bone, as well as the enlarged processes on both ends, which serve as levers upon which the tendons act in a very powerful wing.

From what has been already said, the different parts of this as well as of the other sterna which are to follow, will it is hoped be understood without the somewhat clumsy expedient of letters of reference.

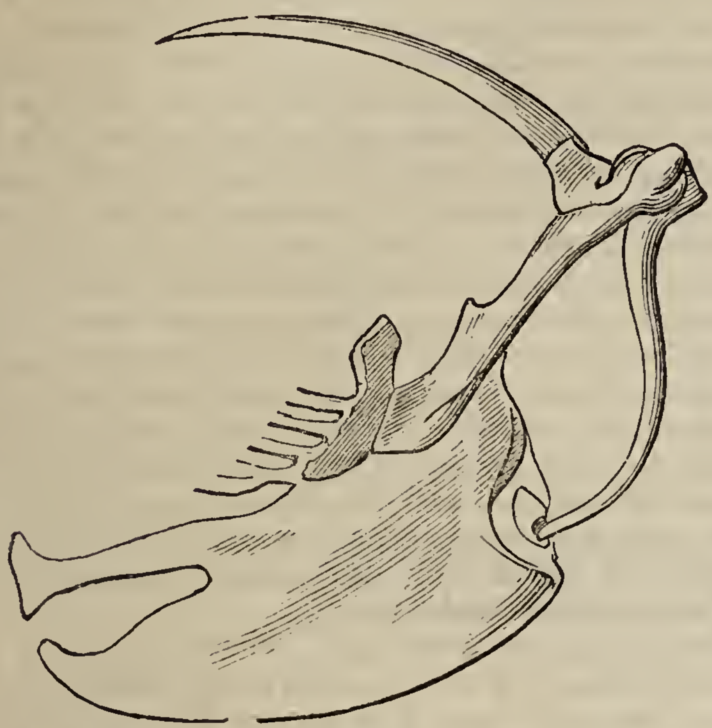
This is the average type of the sternal apparatus of the diurnal birds of prey, to which some are superior and some inferior. The most perfectly formed are the noble hawks or faleons, of which some notion may be formed by looking back at the sketch of the most perfect of the whole, the jer-falcon, at page 405. The short-winged hawks, buzzards, harriers, kites, and eagles follow; and after them the fishing eagles, the vultures, and the skuas, which last, though they do not kill game, yet rush upon the gulls and other birds, which they plunder, with strong and rapid wing. They have, no doubt, their sternal apparatus somewhat modified so as to accord with their webbed feet when they do take to the water, but still they are chiefly and characteristically air-birds.

The secretary falcon, which combines with some of the characters of the diurnal birds of prey some of those of the grallidæ, which frequent not the waters or their margins, has the keel of the sternum less perfect, the posterior edge terminating in a point, and the general outline curved something in the same manner as that of the wingless birds. The clavicle has also an enlarged process at the junction of the two branches, which rests upon the sternum; and the coracoid bones are proportionally much longer than in the typical birds of prey. There is, in short, enough in the structure of this bird (and the habit corresponds) to show that it ought not to be classed with the accipitres; but not enough to bring it properly into any other order or family.

In the nocturnal birds of prey there are also considerable differences in the formation of the sternal apparatus. The snowy and eagle owls, which are more bold and daring than the rest, have the furcal bone formed more into an arch, and the keel of the sternum better developed than in the common owls, which are birds of weak flight, feeding on reptiles and small mammalia, and chiefly in the twilight. But the whole of this division have the skeleton so much more feeble in all its parts than the diurnal preyers that, in a strictly natural system, they ought perhaps to be wholly separated. The common owls have the posterior edge of the sternum with notches, generally two on each side, filled by membranous or cartilaginous matter, and they have the arms of the clavicle or furcal bone straighter, and with its flat side placed more in the direction of the strain than in the diurnal birds of prey. This accords with the comparative slowness of their flight, and the feeble and downy character of their flying feathers.

Sterna of the omnivorous birds. The character of the sternum is much the same in the greater part of those birds which form the extensive and otherwise diversified order of passeres. They have the sternum longer than broad, enlarged toward the posterior extremity, and with two deep notches toward the sides. The keel is moderately produced, convex on its under side, and concave to the front, which has a forked process upon which the middle of the furcal bone rests. The coracoid bones are longer than the sternum, slightly bent, or coulter-shaped, with an enlargement near the shoulder-joints, and narrowed toward the extremities. The clavicle is long and bent downwards at the middle, generally rather narrow, and united to the forked process of the sternum.

The scapular bones are long, bent downwards, pointed at the extremities, but with an enlarged process on the under sides near the middle of their length. The following figure of the sternal apparatus of the jackdaw may be taken as nearly the average of birds of this character.



Jackdaw.

None of the birds which have the sternum formed in this manner capture their prey on the wing, or are very rapid fliers, though they are all birds of considerable power of flight. They are, however, all, at the same time, birds which are tolerably active on their feet; and the large notches in the sternum, posteriorly towards the sides, enable them to make use of their feet, by the flexure of this part of the sternum, while the average production of the sternal crest or keel admits of tolerably powerful muscles for putting the wings in motion. They are so numerous and so diversified in their habits, that no one type can be properly expressive of them all, but their general character is that of uniting habits on the wing and on the ground in nearly equal proportions; and upon comparing their sternal apparatus with those of the birds of powerful wing and the ground birds, it will be found to partake of the characters of both. The different powers of wing in these birds are in a great measure dependent upon the form and distribution of the feathers.

Sterna of the fissirostres. These are all feeders on the wing; but upon comparing their sternal apparatus we find more difference between the diurnal and nocturnal feeders than in the birds of prey.

Day-feeders, or the swallow tribe, have the sternum much elongated, often broader toward the rear than the front, and a little hollow on the upper side. The sternal crest or keel very much developed, concave in its front edge, and convex in its under one, with the angle where these meet very pointed. Front edge of the sternum very narrow, with two grooves separated by a ridge of bone. The outlines of the sides concave, generally with five ribs attached to each, but with six in the white-throated swift (*Cypselus collaris*). Posterior edge slightly rounded, concave on the upper side, and entire, or without any holes or notches toward the angles. The following figure show the sternal apparatus of the common swift of the natural size.

This may, among birds which naturally resort to Britain, if not among all birds whatever, be considered as the typical sternum for continued flight, though not for a powerful but more momentary rush. The sternum of the jer-falcon is the typical or most perfect one for the latter purpose, and the difference between it and the one now given may in part be observed by comparing this figure with the sternum in that of the jer-falcon formerly given; and, if the sternum of the golden eagle is also referred to, the means of judging will be still more complete and satisfactory.

Swift.

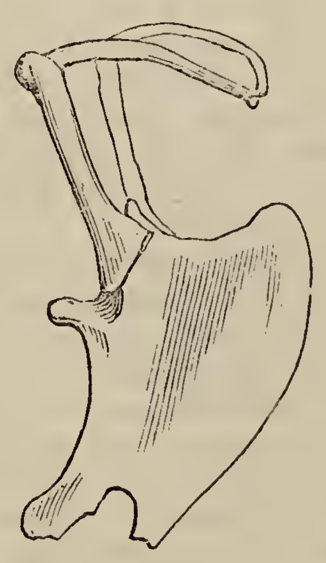
The sternum of the falcon is firmer and more developed in the anterior part than any of the other two, but it is shorter, narrower at its posterior edge, not so hollow, and weaker from the holes at the angles. That of the eagle is larger backwards, more concave, and the holes are nearly obliterated, but still the anterior part of it is broadest. That of the swift has the posterior part broadest, and the angles have no holes. Thus in the falcon the whole strength of the sternum is concentrated upon that part on which the grand flying muscles are inserted; and the more perfect arch and uniform strength of the furcal bone harmonise, and render the whole sternal apparatus the most efficient for powerful flight. There is accordingly no bird which has the same desperate rush as the falcon, and that rush is performed almost exclusively by the effort of the wings, and with comparatively little momentum from gravitation. Indeed a force or momentum produced by gravitation would be a disadvantage to the falcon. She gives chace, and such a momentum would throw her out when her quarry doubles. Thus, though she always attempts to gain and to keep the sky, she never rises to any great height above her prey.

The more produced sternum, and less perfectly formed furcal bone of the eagle, show that her sternal apparatus is not so exclusively, and therefore not so powerfully, of a flying character. The enlargement of the sternum backwards, and the greater strength of the posterior angles, make it more of a carrying basket, though it retains no small portion of the rapid flight character. But strength rather than swiftness is the character of the eagle's wing. The ordinary flight is floating and hovering, and the wings are more employed in bearing her up than in making progressive motion. When she stoops it is always from a height, and no inconsiderable portion of the force with which she strikes arises from the momentum of gravity acquired during the descent. This is further proved by the fact that when the eagle misses her stoop (which, from the goodness of her eye, and the firmness of her body and wing, is not often) she abandons, and takes the sky anew for fresh game; whereas when the falcon misses, she can continue her flight and strike again. The falcon thus more resembles the lightning from the cloud, which produces its effect by its own proper and inherent motion, and the eagle more resembles the ball from a piece of ordnance, which is urged onward by a force not its own.

In the sternum of the swift we have the maximum development of that bone as a carrying basket in the air, but still accompanied with considerable power of wing, though the swift never rushes, either by its power of flight like the falcon, or by a momentum of gravitation like the eagle. Its sternum bears up the whole under-part of the body, and thus it can remain longer on the wing without fatigue than any other bird with which we are familiar. The rest of the tribe are inferior in this respect to the swift; but they all have the same general character of sternum and the same style of flight.

The coracoids in these birds are short and strong; the clavicle open, but an elliptic arch more than a circular one; the scapulars are shorter than the sternum, nearly straight, rather slender, but enlarged a little toward their terminations, which however are pointed.

Night-feeders, or those which feed only in the dusk or twilight, and rest during the day, have their sternal apparatus considerably different. They have the sternum short, widened in front, concave at the sides, and the general outline to the rear convex, but divided into three processes by two large notches. The keel well developed, concave in front, convex in the lower line anteriorly, but becoming straight or even concave toward the rear. The lateral processes with elevated points. The coracoids round in the middle of the bone, but enlarged at the heads, and with a pointed process on their posterior sides, near their junction with the sternum. The furcal bone open, but slender, and the sides not so much arched as in the swift. The following is a representation of these bones in the common goat-sucker of the size of nature.



Goat-sucker.

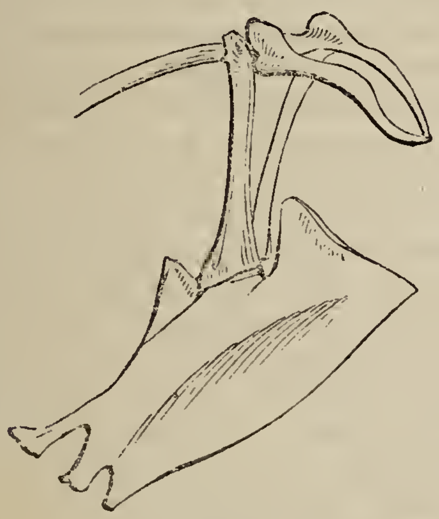
The cuckoo is the bird whose sternal apparatus most resembles that of the goat-sucker; and though the one is a day feeder and the other a night or twilight one, there is a very considerable resemblance in their styles of flight. They are both tree or copse birds, and they never take very long flights when they are in search of their food; and the sternum, from the deep notches in its posterior edge, is not nearly so well adapted for bearing up the body upon long flight as that of the swifts and swallows. Here we may remark, by the way, though the assumption which suggests the remark is now exploded, that there is nothing in the sternum of the cuckoo to prevent that bird from setting upon and hatching eggs in the same manner as other birds do. In their ordinary habit these birds neither fly fast nor take long flights; but the ordinary habit of a bird while resident in one locality is not a certain proof to the full extent of what it can do. The cuckoo flies only from copse to copse, or from one tree in the hedge-row to another; and when feeding its motions are even more limited. But both are very light birds in proportion to their size, and their plumage is soft and loose, so that they float in the air with very easy though not rapid wing. Thus they are able to change their habitat by migration, and appear with us only as summer visitants. In their sterna they bear some resemblance to the owls, with which they also agree in some of their other characters and habits.

Sterna of the syndactyli. These birds are also chiefly dependent on the wing in the finding of their food; but their flight is in general lower than that of the swallows, the prey on which they feed larger, and though not water-birds, or at all capable of swimming, their habits are more aquatic. It is rather a remarkable coincidence with this aquatic habit that the sternum is elongated, and deeply notched in its posterior edge, as in many of the swimming-birds. There is, however, considerable difference between the sternal apparatus of the bee-eater and that of the kingfisher.

That of the kingfisher is more indicative of a power of resisting pressure on the anterior part of the body than of rapidity or even duration of flight; but still it indicates a wing of considerable flying power: the sternum is rather short, and much broader toward the rear than in the anterior part. The keel pretty large, nearly straight in its under edge, and a little concave in front, with the angle advanced a considerable way forward between the coracoid bones. The lateral processes are pointed and produced in front of the junctions of the coracoids. The coracoids are long and strong; and their unions with the sternum are rendered very firm by the projection of the central part of that bone and the lateral processes, which receive and sustain each coracoid as in a fork. The furcal bone is long, open, bent downwards, and much enlarged at the heads of the branches, which are divided into two processes, one in contact with the coracoid and the blade-bone; and the other, which is much larger, passing under and bearing up the head of the coracoid. The blade-bones are also large, flattened, sithe-shaped, and pointed at their terminations.

Thus the greatest strength of this sternum is concentrated upon the coracoids, the furcal, and the blade bones; but when we come to examine the posterior part of it we find it proportionally weaker, so that the keel or origin of the muscles of flight is not so well supported as the shoulder-joint; and that therefore there is, in the sternum of this bird, an indication of some other action of the fore-part of the body besides that of simple flight.

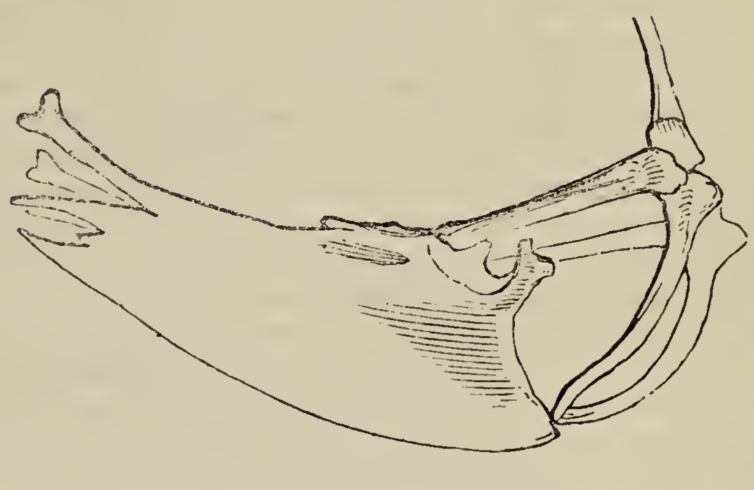
This agrees well with the habit of the bird, great part of whose food consists of small fishes captured when on the wing; and thus the bird has not only to resist the contact of the water with the fore-part of its body, but also to regain the sky with little or no assistance from the feet, while the line of the wings is nearly touching the surface. This is a position from which hardly any bird besides the kingfisher has to recover its flight; for other fishing birds, if we except the eagles and hawks which have that habit, derive assistance either from the bottom, as in the case of the wading birds; or from the water, as in the case of the gannets, darters, and other birds of that tribe. Even the fishing eagles derive advantage from the water in regaining the sky after their stoop. The points of their wings, and especially their broad and firm tail feathers, assist them in working themselves so far out of the water as that they have it under their wings, and thus are able to use these for flight. The twitch which the common kingfisher makes downward upon its prey is performed so rapidly as not to be easily seen; but it is probable that not only the long bill, but also the head and neck, are plunged into the the water, and they are again recovered with equal swiftness, and without materially disturbing the surface; so that this bird requires a very peculiar action of the wing, though it is an action very difficult of explanation. The following figure represents the sternum of the common kingfisher of the natural size.



Kingfisher.

It is found, by examining it in plan, that this sternum is much wider posteriorly than toward the front; but that it is much weakened there, in consequence of the two notches upon each side, the external ones of which divide it to nearly a third part of its length. The difference between this sternum and that of a bird of nearly similar haunt and some similarity of habit, will appear by contrasting the preceding figure with the following one, which represents, of the size of nature, the sternum of the common bee-eater.

This sternum, as will be seen, has some resemblance in shape to that of the swift, only the posterior part of it is rendered much weaker than in that bird by the two very deep notches on each side; the processes that separate which are, with the exception of the middle one which is strengthened by the keel, thin and flexible, though they are widened at their terminations so as to make the posterior line of the sternum nearly a continued curve. The keel is very large, extending the whole length of the sternum, long as it is, and very much curved, both on its ridge, and at its junction to the rest of the sternum. It is, indeed, an exceedingly strong bone, and at the same time a very light one; and if the profile is examined, it will be found that the power of supporting muscles of flight is not diminished by the notches in the sides; for if a straight line is drawn from the anterior process at the insertion of the coracoid to the posterior termination of the keel, it will be seen that this line passes entirely over the solid bone, and that the two processes formed laterally by the notches are not very dissimilar in their situation to false ribs only inserted on the sternum, and not on the spinal column.



Bee-eater.

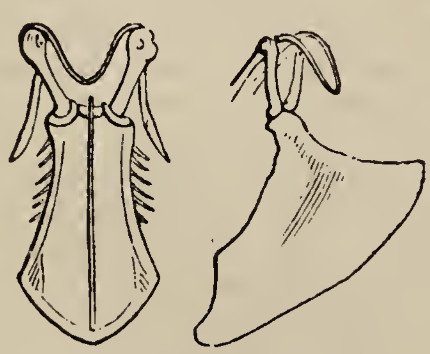
The other parts are equally well fitted for powerful and long-continued flights. The coracoids are long and strongly formed, with their heads much enlarged; the furcal bone is a perfect arch, placed, like that of the falcons, in the position of greatest strength and strongly united to the coracoids. The scapulars also are large and sithe-shaped. The furcal bone is not united to the anterior part of the sternum, though there is a bifurcated process there, neither has it any tubercle or other indication of a junction of two branches at the middle, but consists of one unbroken curve of nearly uniform strength throughout.

This sternum is very beautifully adapted to the habits of its owner. It combines great flying power: length for the support of a body habitually on the wing, and flexibility in the posterior angles, by means of which the bird can better thread its way among obstacles. And the birds of this and the analogous genera are all powerful and long-continued in their flight, although none of them are lofty fliers. Feeding chiefly upon winged insects, by the banks of rivers or over other humid surfaces in warm climates where vegetation is luxuriant, they have to pursue their prey among twigs and branches, the pendent festoons of climbing plants, and the tall stems and large leaves of aquatic ones, so that while they pursue on a swift and smooth forward flight, it is also necessary that they should be able to glide and turn in all directions with the utmost freedom. This facility in turning is very necessary to birds which feed upon insects, many of which are themselves carnivorous, and hawk for their prey in the bushes or on the leaves, and others are to be sought for in the corollas of plants, into which they have plunged for the sake of the sweet juices which accumulate there.

Birds of this family bring us to the margin and surface of the waters, with those races whose habit it is to prey on the wing; but there are still those tribes which feed chiefly by perching on the stems or the twigs of trees, or walking on the ground; and we shall find that, though there are great differences in the sternal apparatus, both of those which have the one habit and those which have the other, according as they combine it more or less with the action of the wings, yet there are characters descriptive of each, that run through the whole.

Sterna of the anisodactyli. Some of these use the wings more and some less, but as they are all more or less walkers on the boles of trees, and other surfaces, on which, from their form, and especially from their position, there can be but little stability arising from the ordinary pressure of gravitation, which is the principal means of stability upon horizontal surfaces, they require to be birds of very ready wing, which can instantly throw themselves upon that part of their organisation, in the event of their claws missing hold. The wing required for this purpose must have muscles of considerable power, and also firm feathers. Such wings have to be used in all positions of the body; sometimes both, and at other times only one of them can act, and they often strike against trees, branches, and other hard substances, so that they require more strength in their whole structure, than wings which are used only in the free air.

Some of these birds also feed on the wing, and feed on the sweet juice of blossoms, to acquire which there must be much use of the wing before even a little bird can procure a meal. Thus, though the wings of these birds cannot be considered as the most general or immediate of their organs in feeding, they are very essential in some, and in all they are auxiliaries which need to be constantly in readiness. As the wings, even of those species which use them the most in feeding, are not used for long stretches, but merely for flitting about from flower to flower, they all have the character of twitching wings, which take the air by sudden jerks more than of wings of forward flight; but notwithstanding this undulating style of flight, some of them get through the air with much rapidity. We shall select as specimens for illustrating the sternal apparatus of the tribe, one of the humming-birds of the tropical parts of America, which is a feeder on the wing, and the common hoopoe, which is a summer migrant in the warmer parts of Europe, and feeds on the ground or on trees.



Humming Bird.

The sternal apparatus of these very small birds is, as may be seen by the figure, remarkably well developed, though, like that of the swallow tribe, it combines not a little of the character of a carrying basket with that of an organ upon which to establish the means of powerful flight. It has a considerable resemblance to the sternum of the swift, being long in proportion to its breadth, and considerably broader in the rear than toward the front. In general it is without notches or holes at the posterior angles. The keel is perhaps more developed in proportion to the size of the whole bone than in any other bird; the coracoids are also short and strong; and the scapulars, from the particular way in which they are bent, take a firm hold in their embedment. The form of the furcal bone is also good, though not a perfect arch; but it is proportionally weaker than the other parts of the arrangement.

We may glean something respecting the highly interesting but exceedingly obscure subject of muscular action, from the study of this sternum. It is higher in the keel in proportion than any other, and the height is continued farther backward than in most birds; but the anterior part, where the great muscles of flight are attached, is narrow, narrower in proportion to the height of the keel than in any other known species. Hence, though the muscles admit of a greater number of fasciculi of fibres than if the relative breadths of the side of the sternum and the keel had been different, yet these fibres must be proportionally shorter.

Now, though muscular action is not capable of being estimated with mathematical accuracy, because we have no measure of any action of the living principle, and the very same muscle is capable of many different degrees of action, arising from health, excitement, and various other circumstances which cannot be reduced to a numerical scale; yet as the action is mechanical in its effects, whatever it may be in its principle, it must follow that the shorter the fibre is the sooner must it be wholly brought into action, and the sooner also must its individual effort be over. All muscular action (as the reader must of course be aware) consists in a contracting or shortening of the fibres, and a proportional increase in thickness. How the shortening takes place is a part of the subject upon which it would not be very wise to offer any conjecture, as it is one upon which we possess no knowledge; but the action itself can be observed, and we may rationally conclude that the times in which equal degrees of excitement are communicated to muscles are in proportion to the lengths of their fibres: that one-half of the length will be brought into action in half the time, and so of all other proportions. This will hold true, whatever may be the absolute length of the time, even though it should be, as it no doubt is in the case of very minute muscles, too short for our being able to measure, or in any way estimate its length in terms of any other motion. But as the shorter muscle must act in the shortest time, so the action of the longer one must be greater, if the requisite time is allowed it—it must contract more, or be capable of moving the same weight over a greater space.

From the indeterminate quantities, which we have no means of separating, or even of expressing, that, as already noticed, enter into the very complex operation of muscular action, what has been now stated can be regarded only as a glimmer in the dark, yet it is far from being without its use, especially in the comparison of structures so varied in their actions, yet all formed on the same general principle, as the wings of birds.

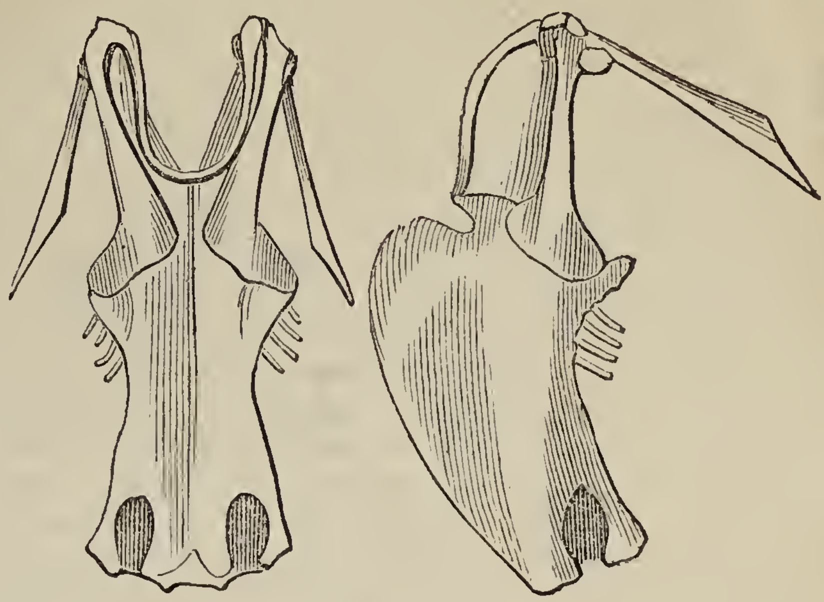
A short muscle will, from what has been said, perform its extent of motion more rapidly than a long one; but it will not move so heavy a member, or move it over the same effective extent at one contraction. Hence we find that birds which rush upon their prey on the wing, have the sternum broader at those parts to which the grand and middle pectoral, which depress and raise the wing in flight, are applied; that (though its tendon is longer, from passing through the pulley) the body of the middle pectoral is shorter than that of the grand, having a lighter labour to perform, but having to perform it more quickly; and that birds which have this habit have the wings, and indeed the whole frame, more solid and heavy than other birds. But we find that in those birds which make no rush, but capture their food in the air at the speed of ordinary flight, as in the swallows and bee-eaters, or which flit about, not in chace of their food, but simply in quest of it, as the humming-birds, the sternum is narrowed in these parts so as to adapt it to the action of shorter muscles, without the load of an additional portion of tendon; and that, in proportion as the habit of these birds requires the action of the wing to be more powerful, the keel is deepened to admit the insertion of a greater number of muscular fibres, or fasciculi.

In birds which fly with equal speed on a level, or an ascent or a descent, the raising of the wing with great rapidity and considerable force is much more necessary than in those which get their most rapid motions upon a descent; and it is especially necessary in the group of birds under consideration, which always have to hold the wings in readiness for being expanded, while they are adhering by the feet to upright or sloping surfaces. Accordingly, they have the middle pectoral larger in its volume, and also in the surface to which its origin is attached, in proportion to the grand pectoral, than birds which have a descent in their rushing motions.

The different style and direction of the flight are not, however, the only circumstances to which the muscles have to be accommodated. The bird requires to be able to make its way through the air the more easily the greater length of time that it spends on the wing, and this easiness of the motion has reference to the respiratory and circulating systems of the bird, as well as to the fatiguing or not fatiguing of the muscles. Now, if we may judge from the analogies, which, as far as we can trace them in all living nature, agree, we must conclude, that, up to a certain rate of speed, the short muscle, moving the comparatively light member, is that which can continue longest in action without fatigue to the muscles, or derangement to any part of the system; but that, beyond a certain rate of motion, the long muscle is the best for speed, though the continuation of its action is shorter than that of the other. We find this in the limbs of the mammalia, and in the feet of birds, whether used in walking or in swimming, as well as the wing, and the principle is one of considerable importance in the economical use of animal power.

The hoopoe, which we shall select as a specimen of anisodactylic feet, with the habit different the most from that of the swimming birds, has the tarsi much longer and stronger, and instead of walking with difficulty on the ground, it walks with a sort of strut, as if it had more power there than what is absolutely necessary for moving it along. The following figures represent the sternal apparatus of the natural size.

It will be seen that the general form of the sternum is nearly the same as that of the humming-bird, but that there are very marked differences in particular places; the keel is lower, but the anterior part of the sternum is better developed; the lateral processes are much larger, and there is a process in front which approaches the furcal bone. The posterior angles are weakened or rendered flexible by two deep notches, and there are only four ribs on each side.



Hoopoe.

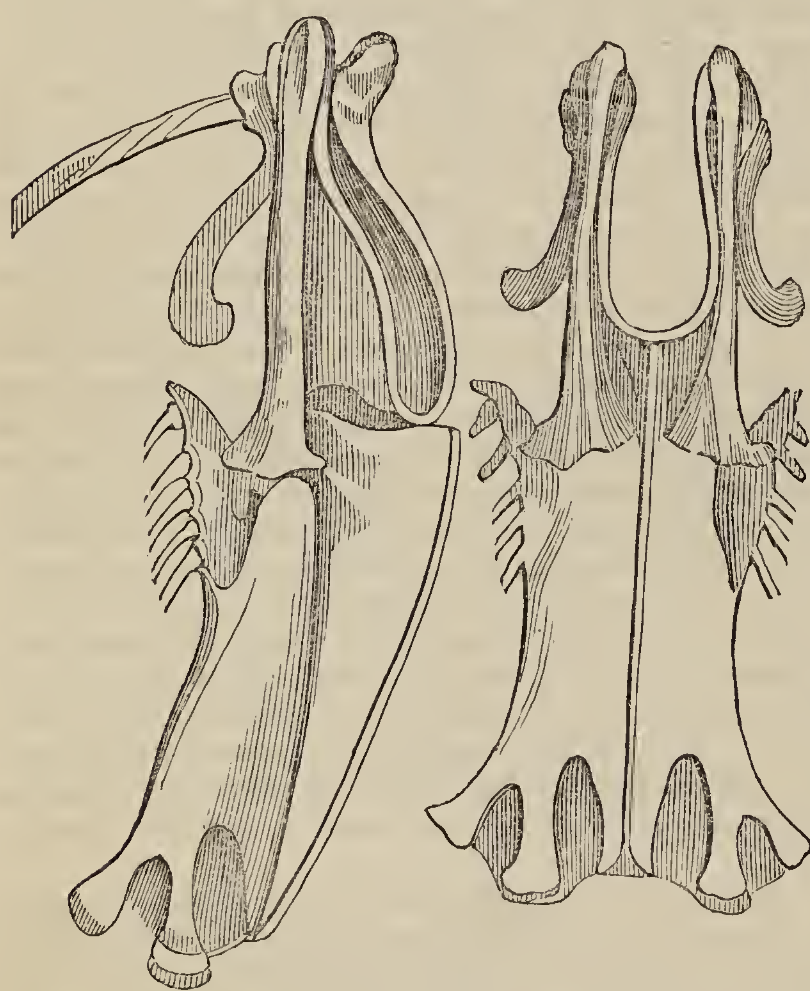
Thus the body of the bird is much more yielding than that of the humming-bird, and bears nearly the same relation to it as that of the swift bears to that of the goat-sucker. The anterior part of the keel is much rounded, and the furcal bone is much bent toward the coracoids, though it does not proceed so straight backward as in the parrot tribe. There is, however, a considerable resemblance in the anterior part of the sternum to that of the parrots, while in the posterior part there is a slight approach to the character of the ground birds. The style of their flight corresponds. It is unequal and jerking, performed with much flutter of the wings, as if the down stroke of these were not very effective, which might be inferred from the rounding away of the anterior part of the keel and the feebleness of the furcal bone. But they can raise the wing with great quickness; and, though their flight is far from being so graceful as their form, they make way with considerable speed. They are birds of the margins of the waters, and especially resort to rivers which are subject to flooding; but they also sometimes hunt for beetles by running along the bark of decayed trees, and often choose the holes of these for nestling places.

Sterna of the Zygodactyli. Of these we shall give as specimens, the sternal apparatus of the common green woodpecker, as being chiefly a bank bird, and resembling in some of its habits the anisodactylic birds, and of the common jacko, or grey parrot, which is one of the most scandent. The cut on next page, that of the woodpecker, is of the natural size.

This is a very peculiar sternum; and upon looking back to what is said of the foot, or, far better, by watching the habits of the bird itself, it will be found to be one of very peculiar action. The bird, while it seeks its food in the holes of trees, or excavates them in making a resting hole for its young, rests chiefly with the sternum pressed against the tree; and it will be seen, upon examining the profile, that the bones are fully as much suited for answering this purpose as they are for flight, though the great length of the sternum, and the production of the keel for the whole of that length, though not very high at any point, still enable the bird to use its wings with considerable effect.

The posterior angles of the sternum are divided by two deep notches on each side, the processes between which are enlarged at their extremities, and, except the middle one, padded with cartilaginous discs; they thus protect the flanks of the bird far backward with a strong cuirass, though flexible or elastic at the sides. The continuation of the keel, however, renders the central part stiff and firm throughout its length, so that it admits of flexure in the flank angles only.

Upon examining the anterior part we find the coracoid bones produced in the direction of the sternum, and as long as that bone; while the furcal bone is nearly a continuation of the line of the keel, and, though not wide in proportion, it is longer than in any example which we have yet adduced. The lateral processes are also very much produced, and two of the five ribs on each side are articulated upon them. The blade bones are of very peculiar shape, being curved downwards at the terminations in the shape of blunt hooks, as if the coracoids, which lie nearly parallel to the axis of the body, instead of approaching it obliquely, as in most birds, were hooked to the muscles near the spine.



Woodpecker.

And this is a highly typical sternum, and one upon which, if space permitted, many observations might be made. Though its peculiarities have much less reference to the style and manner of flight than to the action of the bird when upon the bark, with closed wings, yet they show, and perhaps on that account show more clearly, that the sternum of a bird, that organisation which supports the body, having the spinal column in a great measure bare, is the grand characteristic portion of its structure—the essential part by which a bird is distinguished from every other animal—and the basis, as it were, upon which all the rest of its organisation is built, and in accordance with which the whole of the minor parts are formed.

The main office for which the structure of a woodpecker has to be adapted, is that of maintaining with the under part of the body a vertical position on the bark of a tree, in such a manner as to have the head, the neck, and the spine as far as the lumbar vertebræ (which have a little more motion in this bird than in some others), perfectly free, so that the point of the bill may command the largest possible surface which is compatible with the length of the neck, or move with that force and velocity which are necessary for hewing holes in the wood with the greatest certainty and expedition. For this purpose, the long sternum and coracoids, with the keel and furcal bone on the exterior side of them, form a flat arc with its chord,— the former applied to the tree, so that the fixed point upon which the head and neck move in pecking may be brought nearer to the surface, or moved farther from it, according as may be necessary. If this part (which may be called the base of the bird when in action) had been straight, there would have been more stability in one position, but it would have been only in one, and in that one only when the vertical line of the bark happened to be straight, which is not often the case in those gnarly and decaying trees which afford the fattest pastures for woodpeckers. This, however, would have made the bird work at a disadvantage in excavating a hole to any considerable depth; because, if the position of the centre of action had been immoveably adjusted to any one distance, the action of the bird would have been less effective at every other. But the arched form of the keel enables the bird to keep the centre of action always adjusted for the maximum effect, and that with so slight a motion of the steady or pectoral part of its body that it can hardly be perceived.

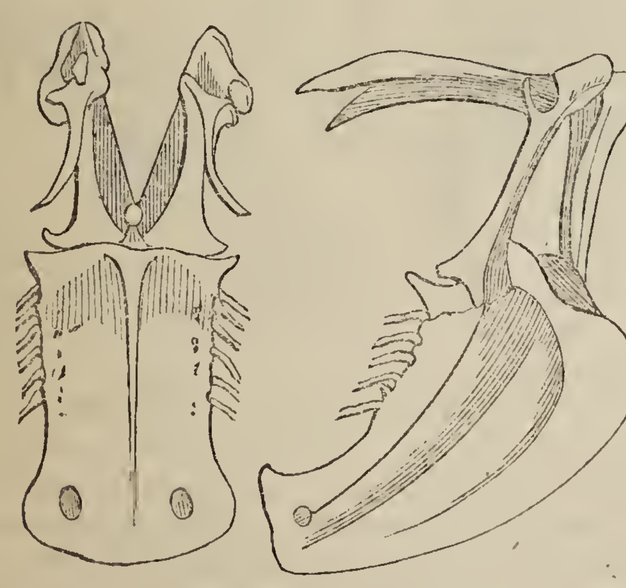
A very little extension of the tarsal joints brings the centre of action more to the tree, and a very little bending of the same joints removes it farther away. Nor is this ready adaptation of the centre to the greatest effect of the stroke the only result of that action of the tarsal joints by which it is produced; for there is the same nice adjustment of the degree of hold taken on the bark to the varying stability of the position. When the centre of action is removed to the greatest distance, the centre of gravity is thrown farthest out, in proportion to the line of the axis, and therefore the weight tends more to pull the bird from the bark; but the very same action of the tarsal joints which produces this, causes the claws to take a firmer hold of the bark, and also the stiff feathers of the tail to bear more against it as a strut. So also, when the centre of action is brought nearer to the tree, and the hold by the foot not so much required, the same extension of the tarsal joint which brings the axis more parallel to the tree eases the clutch of the foot in exactly the same proportion.

Thus, by one of the most beautiful instances of the harmony of parts with each other, the woodpecker is enabled to work with equal stability and effect, while the axis of the body is at all possible angles to the line of the tree, within the range that is necessary for its habit; and yet the different parts of this very curious and apparently complicated organisation are so flexible to other purposes that the woodpecker can at once become a wing bird or a ground bird, when such a habit is necessary.

When on the tree, the woodpecker may be regarded as consisting of three parts, all differently employed; the first of these is the sternum and its apparatus, which acts as the basal or pectoral part, and has no motion except in bringing the centre of action to the tree, or removing it to a greater distance; the second or prehensile part, which consists of the posterior part of the spine and its apparatus, the legs and feet, and the tail; the former of which act as double hooks in holding on, and the latter as a prop or strut; and the third, or immediately acting part, consists of the head and neck, which move with great rapidity without in the least disturbing the other parts. The wings do not come into play, unless when the bird shifts its position laterally, or rises from the tree; but they are, as in the case of all climbing and perching birds, which have much action of the bill when holding on with the feet, always held in readiness, so as to come into action whenever any sudden jerk may require it.

The wryneck, which adheres to the bark of trees something in the same manner as the woodpecker, though its action upon them is different, has the sternum very much of the same structure; only as the wryneck does not hew into the wood of trees, but merely searches the crevices for bark insects, it has a different motion of the head, and the furcal bone differently formed to suit this motion. It cannot strike so forcibly with the bill, or so repeatedly in one place, as the woodpecker; but the wryneck has the joints of that organ remarkably quick and free in their motions, so that when it is searching the crevices, now on the one side now on the other, the well defined mesial line of rich deep brown, which marks the neck and shoulders, appears to be twining up the tree like a little snake.

Zygodactylic birds, which are a very numerous tribe, and the characteristic tree or forest birds of the warmer parts of the world, have many differences of habit, according as they depend more upon flying, walking, or climbing, and according to the nature of their food and the places of the trees, or between them, where they seek it. The sternum is of course modified to suit these differences; and thus no one bird can in that respect be considered as typical of the whole order. That of the woodpecker, which we have given, may be perhaps considered as the one extreme, while the following, which is half the lineal dimensions of nature, may be regarded as the other.



Jacko Parrot.

The posterior part of this sternum bears some resemblance to that of the diurnal birds of prey, but the anterior portion and the attached bones are very different. Its relative length is also nearly the same. But all this similarity of the hinder parts of the two sterna merely shows that parrots and diurnal birds of prey have both a very powerful and firm action in those muscles which move their tarsi or toes, while the different actions depend on the structure of the toes themselves. It is, however, of no inconsiderable importance in facilitating our knowledge of the relation between structure and use in those parts of birds, even those parts which are not immediately connected with each other, to find that the same quantity and power of motion (however different the object) are accompanied by the same general form of the posterior portion of the sternum; and there is still this other relation between the action of the feet in these otherwise dissimilar tribes of birds, that, though they are both powerful clutchers, the one in killing game, and the other in climbing among twigs, they are both very imperfect walkers on the ground.

When we come to examine the anterior part of the sternum—that on which the character of the flight more immediately depends, we find that, though the wing of the parrot must, from both the depth of the keel and the breadth of the sternum, be a ready wing, yet it must be comparatively feeble and unsteady.

The lower ends of the coracoids do not form an angle of about sixty degrees, with these edges attached to the sternum, as is the case in all the falconidæ of powerful wing; neither are their axes directed toward the strongest part of the keel of the sternum, either when viewed in front or on the side, as those of the falcons are when viewed both ways. Their union with the sternum, though not quite a straight line, is upon the whole at right angles to the axis of the body when seen in front, and they are nearly parallel to each other; and though enlarged at the heads, not nearly so robust as those of the falcons, although rather longer in proportion. In their articulation on the sternum, and their position with regard to each other, they have thus very little stiffness in resisting the approach of the shoulder joints toward each other; thus in this respect they are to a great extent the very opposite of those of the falcons. And this flexibility which the coracoids have for bringing the shoulder joints together, is not counteracted by any great strength of the furcal bone; for, though the two extremities of that bone are enlarged, the branches are slender and straight, which renders them as feeble as the coracoids. Even the blade bones are not formed for taking a very firm hold in their embedment.

Thus when we examine the point of articulation to which the wing of the parrot is attached, we find it a very feeble one, and one which could not be used in long flight, without great fatigue to the bird. The coracoids and branches of the furcal bone are placed in that position in which they are the least fitted for resisting that strain on the shoulder joint which is necessarily given when a bird flies rapidly; and they even appear to be loaded with an additional quantity of bone at the joint, for no other apparent purpose than that the joint may be the more unsteady, and the flight of the bird the more feeble and laborious. We would thence, if we reasoned only from the relative structures of the sternal apparatus, be apt to conclude that nature has given to the parrot tribe similar power of foot with the birds of prey, but shorn and crippled them in those characteristic organs of birds, the wings.

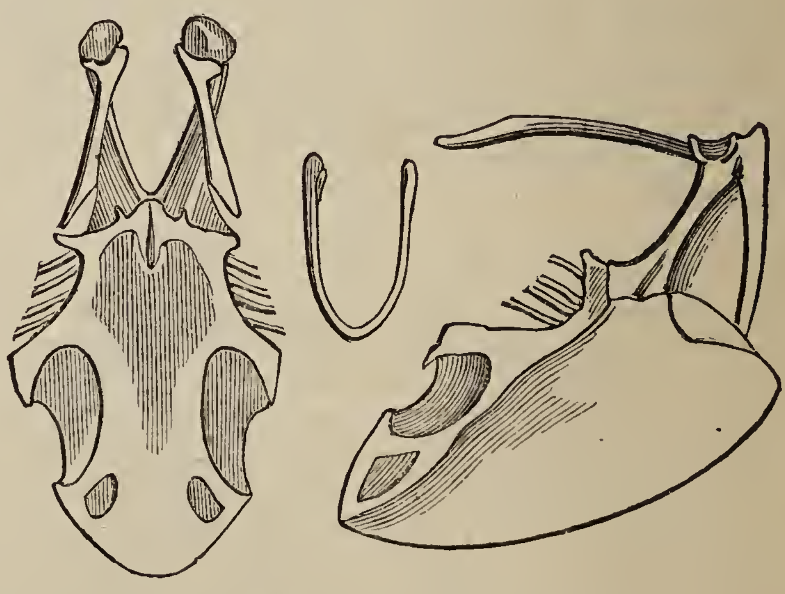
When, however, we take the haunts and the habits of each into consideration, we find that not the jerfalcon herself, in the pride of her finest flight in the free air over the bleak and bushless wild, affords us a better specimen of exquisite mechanical skill, both in the design and the accomplishment, than the parrot among the tangled sprays of a tropical forest. The fine wing of the falcon would avail her nothing in such a place: for it is as unbending as the spirit of the bird; and one stroke of it taking effect on the branches, which in the habitation of the parrots she could not avoid, would fracture the wing, firm as it is, or at all events throw her off her poise, and tumble her to the earth, defeated, helpless, and fit only for food to the snake or the vulture, if even they did not scorn her as a meal.

But the wings of the parrot are, from the looseness of their articulation, proof against any such casualty; so that, though the bird move and flutter them ever so much among the thick sprays, or have to use them in the most awkward situations, in making way from perch to perch, when the distance is too great for the reach of the foot or the bill, they do not sustain the slightest injury. From the flexibility of the wings of these birds in the joints of their bones, the bones are not only saved from danger of fracture to which more firmly-jointed ones would be constantly exposed, but the feathers are also less liable to be ruffled or injured by striking against the twigs and branches than the feathers of those stiff wings which are adapted for more forward and rapid flight are by the contact of the air, when they deliver their strokes from their comparatively immoveable points of articulation on the firmly-knit shoulders.

All forest birds, which have to make their way among twigs and leaves, and all birds generally which are liable to come in contact with obstacles in the stretching out or in the subsequent use of their wings, have them more or less of this yielding structure, according to the necessity which they have for it, so that, whatever may be the difference of the place of resort, or of the hazards to which any creature may be exposed on account of these, the creature which is native, or in its natural and accustomed element, in them, is just as much at home and as safe in the one as in the other.

It is this universal perfection of adaptation which renders the study of nature, the more extended and liberal the scale on which it is conducted, the more gratifying to the best feelings, and the more cheering to the best hopes of man. When we study the different parts of the world, in their climatal differences and in their productions, we find that they are dependent upon the structure and form of the earth's surface, the motions of the earth around the sun, and the reciprocal actions of earth, water, and air, with those of the relative positions of the sun and moon upon both; but that, in all the varieties of climate, and all the differences of surface and vegetation which are produced by those numerous and complicated causes, the animal, to what class soever of animated nature it may belong, is so true to all the rest of the system, that they must be all parts of one design—the workmanship of One Almighty and All-seeing Architect, who required to proceed by no such experience of steps or induction of particulars as that which hems in the widest flights of our invention; and that, ere one particle of the whole system was in existence, every possible part of the complicated whole, and every variety of which any one is susceptible (even those which, to our confined perception of the matter, appear anomalies or imperfections) must have been far more clear and simple than is to us the simplest work which we can perform, after we have performed it the greatest possible number of times. If we attend only to the single organ, we cannot but admire the perfection of workmanship which it displays; but when we, to so humble an extent as our limited powers enable us, endeavour to think of the whole, our admiration changes to the most complete astonishment, because the utmost effort of our powers can no more fathom the depth of design, which is apparent in whatsoever portion of nature we study, than the span of our fingers can measure the extension of the universe.

Sterna of the Columbadæ. Though these birds are not climbers, and the greater number of them seek their food upon the ground, chiefly vegetable, though some of them also eat insects, yet they retain in the sternal apparatus some of the characters of the climbing birds; and there are, among the species found in warm countries, some which have the colours of the plumage as brilliant as any of the climbing or zygodactylic birds. They in general perch in trees, or in the holes and on the ledges of rocks; but there are some species which reside chiefly on the ground. There are also some which, in their general appearance, and partially also in the form of the sternum and its apparatus, have some resemblance to the gallinaceous or poultry birds; and of these, as is the case in that order, there are some which nestle in trees and some on the ground. The race are indeed considerably diversified; but still the more typical ones, in many particulars of their sterna, preserve a resemblance to the climbing birds. The sternum of the rock-dove, which is usually considered as the parent stock out of which the numerous varieties of domestic pigeons have been bred, may be selected as about the average.



Rock-dove, half the lineal dimensions.

In the development of its keel, this sternum bears some resemblance to that of the parrot; but it is better formed for flight, as the keel is more advanced in front, and the angle, though rounded off, is not so much so as in the other. The central portion backwards is much more produced, and it is rendered stiff by the continuation of the keel; but the angles are cut off, which gives the entire bone a sort of lozenge form; and the sides are weakened by the two holes and two notches which appear in the figure. The coracoids, though not very strong, are much better set at their junction with the sternum than those of the parrot. They have not that direct bearing toward the centre of the sternum which we find in the more typical wing birds; but their axes do form an angle with each other as seen in front, and the position of the lines of their union tends also to throw the pressure on their heads toward the middle of the sternum. The clavicle, though by no means of the strongest form, is much firmer, in comparison with the quantity of matter that it contains, than the clavicle of the parrot. It is an arch, though an elongated elliptical one, and therefore comparatively weak against lateral pressure on the extremities, though not so much so as a fir with the branches nearly straight, and its process at the middle bearing on the head of the sternum. Thus the sternal apparatus of this order, though far from being so firm as that of those birds of which the air is the principal element, is not so flexible as that of those birds whose chief action is walking upon legs so articulated as to support the axis of the body in a horizontal posture. The pigeons are thus, in their structure, intermediate between air and ground birds; and they are, on the average, the same in their habits, though, according to this habit, they might perhaps admit of division into four groups. First, those which feed, habitually or occasionally, upon seeds and berries, while these are yet on the plant, the tree, or the bush. Of these the migrant pigeons of the south-east, which are gay in their plumage, and which, though they have perching rather than climbing feet, yet have some resemblance to the parroquets, are the most typical. Secondly, those which, though they feed more on the ground, yet perch and nestle habitually on trees, of which we have British examples in the common ringdove, and in the rarer stock-dove and turtle. Thirdly, those which feed on the ground, and roost and nestle in rocks, of which the rock-dove may be regarded as the type, and all the varieties of pigeon-house and domesticated pigeons as instances. Fourthly, those which bear so much resemblance to the gallinidæ that they are popularly called gallinaceous pigeons. Of these one species is as large as the common turkey, or larger. Some of them nestle in trees, and some on the ground, but they are all lower fliers and less discursive in their range than the true pigeon; they are also much more omnivorous, and on this, as well as on other accounts, they ought in a perfectly natural system to stand as a separate family, if not as a distinct sub-order.

Before proceeding to notice the sternal apparatus of the gallinaceous tribe, it may not be improper to remark that the flexibility of the lateral parts of sterna produced by notches of the bone, or cartilaginous continuations, are intimately connected with the power of walking straight forward upon two legs, in birds which have the use of their wings in flight, and which consequently have furcal or clavicular bones, though the form and strength of these vary with the powers of flight.

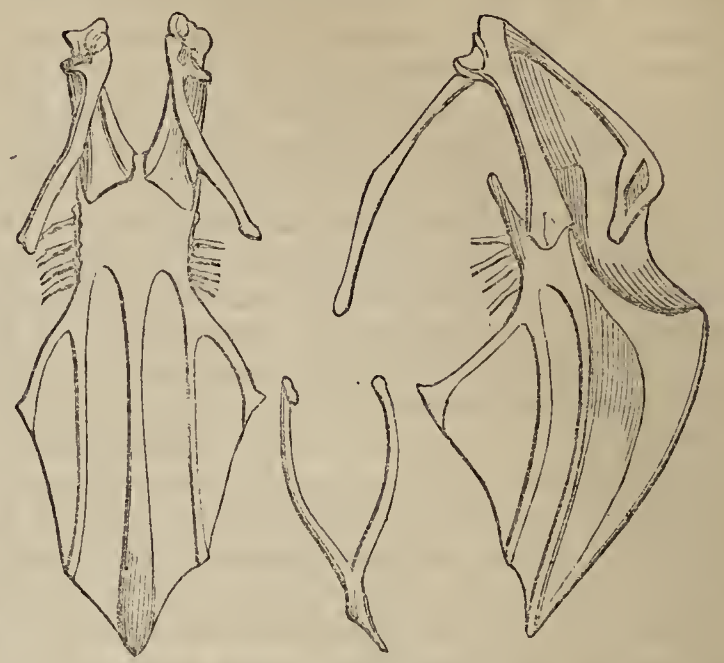
It will be readily understood that the clavicle ties the shoulder-joints together, and the coracoids at the same time keep them both at equal distances from the anterior angles of the sternum, so that the line joining the shoulder-joints is immoveable in position with reference to the sternum, except in so far as the different articulations are loose and admit of play, and the change of position produced in this way is very limited. Consequently, if the sternum were inflexible (as it is in birds of powerful wing) in clavicled birds which walk by striding with the alternate foot, and not by hopping with both feet at once, the line of the bird's body would twine about like a cork-screw as it marched along, as the advance of each foot would necessarily throw the anterior part of the axis to the opposite side, and give the bird a swinging motion upon its centre of gravity, which would considerably increase the fatigue of walking, and thus be a violation of that general law according to which all the natural actions of animals are performed with the smallest possible waste of their energy. We see instances of this swinging of the axis in several flying birds when they walk by steps; and it is more conspicuous in proportion as the tarsi are longer, and the tibiæ more moved in performing the step. But such birds have generally the tarsi rather short, so that on their quick marches upon the ground they take short trundling steps, or they hop, as is the case with most of those *passeres* which are habitually or occasionally ground feeders. In order that the progress may be by steps of considerable length, it becomes necessary that, if the shoulders require a stiffening clavicle to fit them for flight, the posterior part of the sternum and also the ribs, but especially the former, should be flexible, in order that the one side may contract and the other expand on the advance of the leg, as much as shall keep the axis of the body steady to the line of motion. We have a perfect confirmation of this in the sterna of gallinaceous birds, all of which are straight-forward runners, and runners without hopping. Many of the long-legged birds also run fast and steadily forward, and never use any action of the feet for that purpose, except the alternate one; but the particular structure of the bones, by which this is accomplished in them, can be more advantageously explained afterwards.

Sterna of the Gallinidæ. The sternum of these birds has, in its general outline, the lozenge form which characterises that of the pigeon tribe, only it is more elongated in proportion to its breadth. As in these, the anterior part of it is the firmer, but the posterior part is much more flexible, consisting of five processes of bone, all narrow and slender, with the notches next the middle by far the deepest, extending, in fact, fully more than three-fourths of the entire length of the sternum; and the two lateral processes, though united by cartilaginous membranes to each other and to the central bone, having more the appearance of a forked sternal rib than of portions of the sternum as a continuous bone. The keel is considerably developed, especially in the anterior part, but lower toward the rear, though there it still affords some stiffness to the middle portion of the sternum. The anterior part of the sternum terminates in a triangular process, which is notched at the edges to receive the coracoid bones, and the lateral processes extend forwards nearly as far as the triangular one in the centre. The coracoids are rather strong, flattened on their anterior edges, and with an angular ridge backwards. The clavicle is a semi-ellipse, more elongated, and with the branches much more straight, feeble, and flexible, than in the pigeons. It has always a process at the union of the two branches, often of considerable size, and directed toward the anterior part of the keel to which it is united. The shoulder bones are rather large, broader in the middle than toward the extremities, and a little bent.

The whole structure of this sternal apparatus shows that its strength lies much more in the vertical plane than in the horizontal, and consequently that it is better adapted for supporting the body of the bird, while walking or running, than for giving steadiness to the wing in flight. The coracoid and the clavicle stand upon the sternum like two sides of a triangle, of which the anterior parts of that bone and its keel form the third side or base, and thus the shoulder-joint is kept at the same vertical distance from the sternum. The enlargement of the blade-bone, too, gives that joint a firm suspension in the muscles of the back, and this, with the other structure of the bones which have been mentioned, causes the sternum, and the viscera which it supports, to hang, in a great measure, upon the upper part of the back, from which the support is continued through the bones, and furnishing a larger supply of muscles for the support of the legs than in air birds. But this very arrangement, which makes these bones steady, or comparatively stiff, in the vertical direction, and connects them with the legs as the grand organs of motion, renders them more flexible, or less able to resist a strain in the cross direction. This is a general principle in mechanics, that when any arrangement of pieces, framed by carpentry, as one would say, have the greatest possible strength in any one plane, they have always the least possible in the plane at right angles to that one. A truss which supports the most extensive roof, as, for instance, one of those beautifully scientific ones which support the roof of Westminster Hall, would break in pieces by its own weight, if an attempt were made to support it horizontally by the ends of the rafters; and even if it were laid on its side, with the ends of these and the vertex on two walls of equal height, all the framing, which makes it so stiff and strong, when it stands upright, would be just so much of a load upon the rafters, by which they would be weakened to its full weight, from the strength which they would have if laid single at their full length upon two walls, to the general lines at which they were at right angles.

This structure, which throws the strength of the sternal apparatus into the plane in which the legs are moved in walking, is the grand characteristic of a ground bird, and the very opposite of that of a bird of powerful wing, which has the plane of greatest strength in its sternal apparatus nearly at right angles to the plane of walking; and therefore the power of walking in the latter bird is the smallest possible in proportion to the articulation and muscles of its legs, just as the flying power of the gallinaceous, or ground birds, is the smallest possible in proportion to the articulation and muscles of their wings.

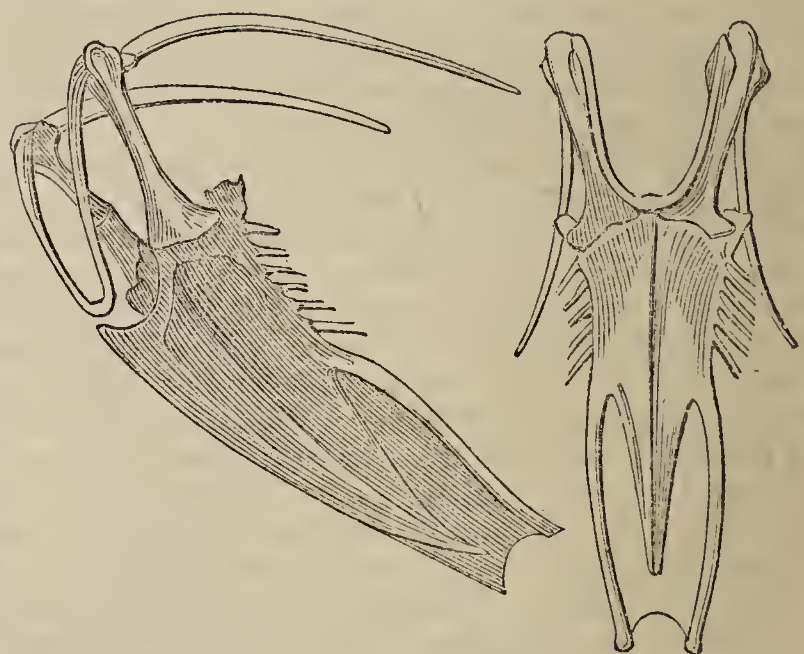
Birds of this order are numerous; and, though there is perhaps fully as much similarity of habit among them as among the different species of any other order equally numerous, yet there are slight differences. The common partridge, as one which is among the fleetest runners, runs almost the instant it is out of the shell, always rests or squats as well as nestles on the ground, and seldom takes the wing, may be considered as one of the most typical; and it has the farther advantage of being almost the only one which, in a state of nature, may be seen and studied alive in every habitable district of the British islands. The following figures represent its sternal apparatus, half the lineal dimensions of nature.



Common Partridge.

Sterna of the Gallinules. Birds of this tribe may be considered as in their habits forming a connecting link between the gallinidæ and those swimming or diving birds which have the feet lobed or webbed, and they may be taken as an average type of the *Long-toed birds* of Cuvier's arrangement.

The following figures represent the sternal apparatus of the common gallinule, half the lineal dimensions of nature.



Gallinule.

This sternum, as may be seen from the figures, is very long and narrow, broader toward the ends than at the middle, divided posteriorly into three processes, by means of two deep and wide notches, which are filled by cartilaginous membrane. The middle process is rather longer than the solid portion of the sternum, and terminates in a blunt point. The lateral ones are more than one and a half times as long, and are a little broadened at the points, and the edge of the membrane between them is concave. These lateral processes are flexible, and may be regarded as oblique sternal ribs for supporting the planks of the bird, rather than as portions of the sternum in supporting the organs of flight. The middle process is rendered stiffer by the keel, which, although not high as compared with that of many other birds, is high in proportion to the width of the sternum. This keel is convex on the under side and concave on the front, the angle pointed, and surmounted by a small bony process outside. The lateral processes are inclined forward and upward, and there are six ribs between them and the posterior lateral ones. Coracoids short, but well formed, and moderately well set for giving firmness to the shoulder joint. The clavicle is a long semi-oval, rather slender, but without any process on the under side at the union of the two branches; but there is a small tubercular process on the upper side. The scapulars are very long, and a little bent downwards, and thin.

This sternal apparatus indicates considerable power of flight, though, from its narrowness, the stroke of the wing must be quick and rather feeble. The central posterior process gives a firm support to the middle of the under part of the body; and the lateral ones, from their great length and flexibility, support the flanks, and at the same time enable the body to accommodate itself to those obstacles among which, from their habits, the birds have to find their way. The narrowness of the sternum in proportion to its length, and the accordant general shape of the bird, also conduce to the same purpose, and the straightness of the sternum enables it better to resist pressure in the direction of its length than the curved sterna of other birds, though these support much more powerfully the flying motion of the wing.

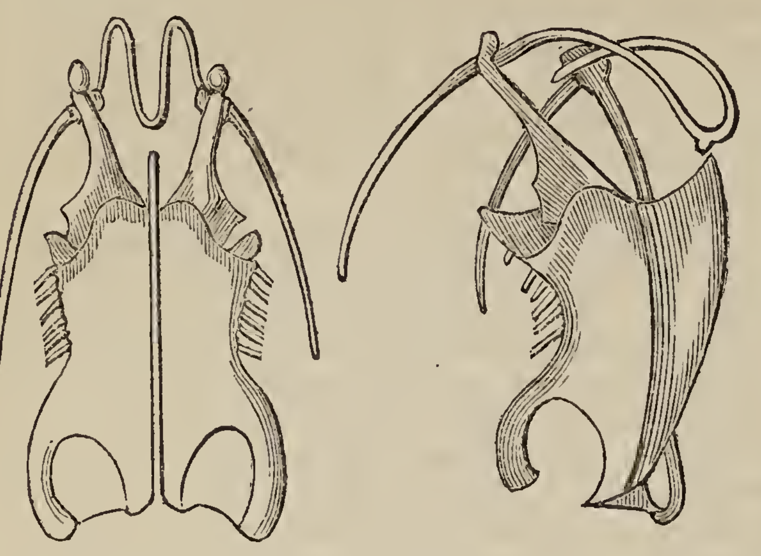
Many of the birds which have the sternum of this form are swift and smooth runners, and all, or at least most of them, run with the head advanced nearly in a line with the axis of the body, which is carried horizontally. The head, too, is small and pointed, and the shoulders are narrow and tapering. This form of the body enables the birds to make their way among the tall herbage of humid places, and especially the banks of brooks and streams, and the reedy margins of pools and shallow lakes in rich and flat countries, where they seek the greater part of their food. Many, if not all of them, can at times enter the water, and, when they are immersed to a sufficient depth, they use their wings for motion in that element. The narrow sternum, and the consequently short and rapid motion of the wings, are much better adapted for action in the water than wings which take longer strokes, and are more powerful and efficient in the air. This can be readily understood when it is borne in mind that the raising or recovering of the wing is a much more laborious operation in water than in air, and that the power requisite for working long wings, almost to the full circle, as is done by air birds, would in water be greater than any ordinary structure of a bird could be supposed to possess. Besides, when wings are used under water, they must keep time with the feet, and hence they are never moved far from the horizontal plane of the body, but strike short and quick, and move most forcibly downwards or upwards, according as the course is ascending or descending.

The natural transition here is not to the running and wading birds, which resort, at least in most of the species, to the banks, shores, and other humid places, which are not so tangled and rank with vegetation as the haunts of the tribe now considered. These carry the type in the general form of the body and the sternal apparatus, though modified by the habit and haunt, from the grebes, which unite considerable powers of flight with swimming and diving, through the divers properly so called, to the penguins, which are incapable of flight; but those species which use the wings chiefly in the water as a sort of fins have the sternal apparatus, of course, different from those that use them in the air.

Sterna of the Divers. There is so much diversity of habit, as well as of sternal structure, among these, that it is impossible to select any single species as an average type. We shall, therefore, give three instances which correspond in some measure to the two extremes and the mean—the grebes, the true divers, and the penguins.

1. *Sterna of the Grebes.* The sternum of these birds is intermediate, in its general form, between that of the coots, as the aquatic extreme of the preceding group, and that of some of the diving ducks, or rather those of the eiders and scoters, which are intermediate between the swimmers and divers of the duck tribe. The sternum is short and broad, and much broader in the rear than the front; but the breadth in that part does not consist so much of continuous bone as of two posterior lateral processes, which are divided from the central part of the bone by notches of considerable depth. These processes are much stronger, as well as shorter, than those of the birds in the preceding family. They are arched, rising upward at their divisions, and recurving again toward the middle portion, though not joining it. The keel is well developed, though its height is not equal to the breadth of one side of the sternum. It is convex on the under side, and concave in front, with the angle sharp, but without any production of bone. The margin is triangular and cartilaginous. The coracoids are of moderate length, rounded on their anterior sides, and flattened and much enlarged in the rear. They are strong, and well set for giving firmness to the shoulder-joint, as they form a considerable angle with each other, and also with the general line of the sternum; so that the strain which they exert when the wings are moved is directed toward the point of greatest resistance in that bone, which is, of course, also the mean centre of the surfaces to which the muscles which move the wings are attached. The clavicle is long, forming a regular semi-ellipse, attached by a small tubercle at the middle to the angle of the keel, flattened laterally, and forming, from the head of the coracoid to the keel, a perfect arch, with its convex side to the front, and the terminations of its branches bear against the heads of the scapulars, the greater part of which is slender, and slightly bent downwards. The general shape may be seen in the following two figures of the sternal apparatus of the eared grebe half the size of nature.

The breadth of this sternum, the convexity of its under side, the form and size of its keel, the strength and setting of the coracoids, and the opening and curved form of the clavicle, all indicate considerable action of the wings. Its stoutness and firmness in the posterior part also indicate considerable action of the legs, not of the tarsi merely, but also of the tibiæ, and not in the vertical plane, as in the common operation of walking, but in a direction contrary, or at all events oblique, to that plane. A sternum which best suits for a walking motion is that which has the posterior angles taken off, so that the whole has a lozenge shape, as in poultry and pigeons; and one which answers best for the alternate foot motion of swimming on the surface of the water is of a punt or boat shape, which bears up the body equally. But the sternum of the grebe does not answer to any of these characters: it is shortened, as in the birds of prey, to admit a free motion of the legs, and the lateral processes backward are formed into a sort of strong, yet partially flexible arches, for defending the sides of the bird.



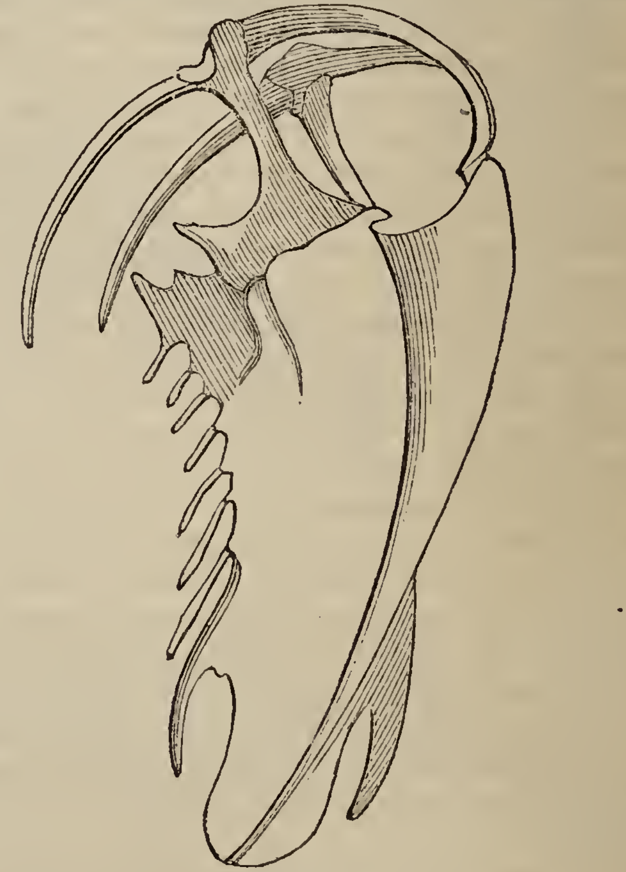
Eared Grebe.

The structure of the shoulder is also well worthy of attention. The form of the clavicle resembles that of birds of prey, both in its curvature of opening and its curvature downwards. The strength arising from these curves is, however, reversed to that of the predatory birds. In them the curve of the opening is the more perfect arch, and the bone is flattened in the direction of that arch; whereas, in the grebes, the lateral arch, which extends from the angle of the sternal keel to the head of the scapular, is the better formed, and the bone is flattened laterally to give additional stiffness to that. The head of the clavicle also bears against that of the scapular something in the same manner that the arch of a bridge bears against its abutment; and the scapular, by becoming narrow toward its termination, resists a thrust on the head much better than it resists a pull.

From this formation of the shoulder, it will be seen that though it forms not an unsteady fulcrum for the action of the wing in flight, it is also well calculated for resisting a strain or pressure from the front; and from the posterior portion it may be seen that provision is made there for a peculiar action of the feet. The sternal apparatus of the grebe is thus a very typical one; and when the small and elongated head and neck, and the lobed toes, with the flattened tarsi, turned outwards on their articulations, are taken into consideration, one might almost arrive at a knowledge of the habit of the bird without further investigation. No air-bird, not even the most typical of the falcons, presents the most powerful arch of its clavicle to the air against which it flies, neither has it the extremities of this arch resting on the angle of the keel and the head of the scapula as abutments, as is the case in this bird. Thus it is evident, from the structure of the shoulder alone, and independently of that of the foot, that the grebe is formed for making its way through the water, and not merely along the surface, though the resemblance of the sternum to that of some of the ducks shows that it is also in part a surface swimmer; and this inference is rendered the more certain by that resemblance being to the ducks of the intermediate division, which have the swimming habit and the diving one in nearly equal perfection.

2. *Sterna of the true Divers.* In these birds, the duck-like character which is traceable in the sterna of the grebes disappears; and while the sternal apparatus presents a still more powerful arch in front, the posterior part of it is continued so as to support more completely the under part of the bird.

The sternum is long and narrow, a little concave on the upper side, and convex on the under; the keel well developed, higher in front than the breadth of the side of the sternum, concave in front, and much advanced at the angle; the under side convex, but less so than that of the sternum, and gradually diminished to the rear, having the middle process, which is broad and rounded, a little flexible. The sides are concave, and have seven or eight ribs on each; and the lateral processes, which are rather slender, and have their terminations curved toward the central one, have the appearance of two short sternal ribs in addition. The anterior lateral processes are large, and have their points directed upwards; and the coracoids, which are strong and short, have their bases very much enlarged to the rear, and with large processes projecting in the same direction as the lateral ones. The clavicle is very much curved downwards, with a tubercle at the middle, bearing on the angle of the keel (which is more rounded than in the grebes), but not articulated to it. The branches of the clavicle are flattened laterally, rather slender at the middle point, but much enlarged at their union with the coracoids and the scapulars. They abut against the latter bones by a head consisting of two processes, and the coracoid has its enlarged head applied over the junction of the two, and a process underneath, which bears up the head of the clavicle. The scapulars are rather slender, bent into a regular curve, and tapering a little toward their points. The following figure of the sternal apparatus of the red-throated diver (*Colymbus septentrionalis*), in the proportion of half the lineal dimensions of nature, and shown obliquely, half on the under side, half on the profile, will afford a better idea of these energetic careerers through the water than could be obtained from two separate views.



Diver.

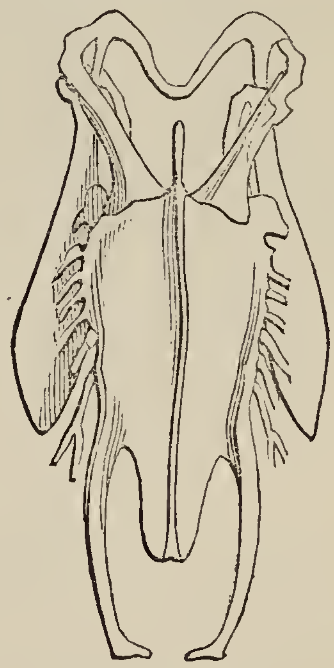
On examining this figure, it will be seen that the keel of the sternum, the clavicle, and the scapular of this apparatus, form nearly one continued curve, which does not bear so much on the angle of the keel, and therefore does not press so much upon the sternum, and the viscera which it supports, as in the grebes; while the sternum, from its greater length, gives more firmness to the under part of the body. The great strain of the shoulder, as the bird moves through the water, is upon the coracoid, chiefly to turn that bone backwards; and this is resisted by the great enlargement backward at the base, and the embedment of the process of the coracoid and that of the anterior angle of the sternum among the flesh of the shoulder. So that, while the resistance is very powerful, it is at the same time elastic, and not a direct thrust of bone against bone, which would occasion a direct prolongation of the strain through all the bony connexion, instead of an extinguishment of it among the neighbouring parts, as is the case in the mode of articulation here presented. Those direct or jarring strains, propagated all in one direction, are never found in the mechanical structure of animals; but, on the contrary, the greater the strain upon any one part, the more speedily and widely is it distributed over a number of other parts.

The form of the clavicle is also a very beautiful part of this structure: the enlargement at the shoulder-joint, the gradual diminution in weight as the bone becomes more curved in approaching the keel, and the way in which the head of the clavicle is united to that of the scapular, so as to bend that bone more firmly against the ribs near the inflexible part of the spine, when the pressure of the water tends to bend the clavicle itself toward the angle of the sternal keel, are all well worthy of close observation: the more so that the natural action of the bird in the water cannot be so easily seen as that of a land bird in the air. Even the point of articulation of the wing is worthy of notice, as having the line of its principal action more in the direction of the general axis of the body than that of wings which are used exclusively in flying. Taken altogether, the divers afford one of the finest and most instructive instances of mechanical perfection which is to be met with in the whole feathered race. Not that their structure is better adapted to their habits than that of any other tribe, for in this all birds, and indeed all animals, may be said to be alike; but their action is particularly energetic; and the energetic action strikes us with admiration, while in the case of that which is less conspicuous we must examine before we can admire. Those striking cases are of course the ones which it is best to present to those entering upon the study, whether the object be to produce love for the productions of nature, or the inseparable adjunct of that love when grounded aright—veneration for nature's Almighty Author.

3. *Sterna of the penguins.* In these birds the wings,—which in the divers, and also in some of the intermediate genera of auks, are capable of tolerably rapid and prolonged flight, so that the birds can not only range over the surfaces of the bays and landward parts of the sea, but migrate from one latitude to another as circumstances may require,—are incapable of every thing which can with propriety be called flight, though they assist some of the species in a peculiar kind of leaping motion by which they can clear any obstacle with which they meet, by leaping three or four feet clear of the water. English sailors call those which have this habit by the not very inappropriate name of "Jumping Jacks."

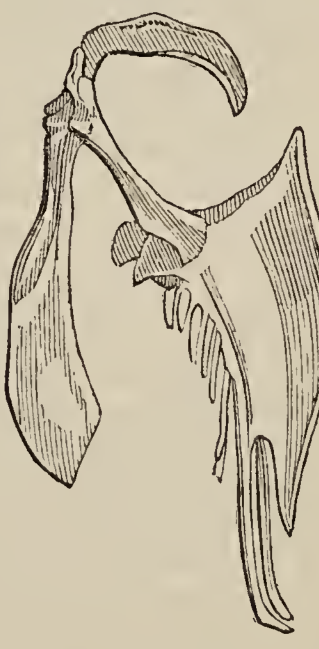
These have the sternum clongated, with the keel well developed, pointed at its angle, and extending considerably in advance of the sternum. The anterior edge of the sternum with two large furrows, terminating in a depression in some of the species, and in a perforation in others. The sides of the sternum concave in the anterior part, and convex in the posterior. The concave portion having six ribs attached, the last one double; and the convex consisting of a slender process, extending backward to a considerable distance beyond the termination of the middle portion of the sternum, bearing in this respect a very considerable resemblance to that of the gallinidæ.

The coracoids are long, strong, flattened, having the inner edge formed into a lamina, which is perforated, and bears at its upper extremity a process of the clavicle. The clavicle has a very peculiar shape, which will be better understood from the following half-size plan of the sternum of the Cape penguin than from any verbal description.



Cape Penguin.

The scapulars are very large, much broader than in any other species of bird, and bearing a trace of resemblance to the same bones in the mammalia. Their form will be better seen in the following profile



Profile of the Cape Penguin.

of the sternal apparatus of the same bird, represented on the same scale.

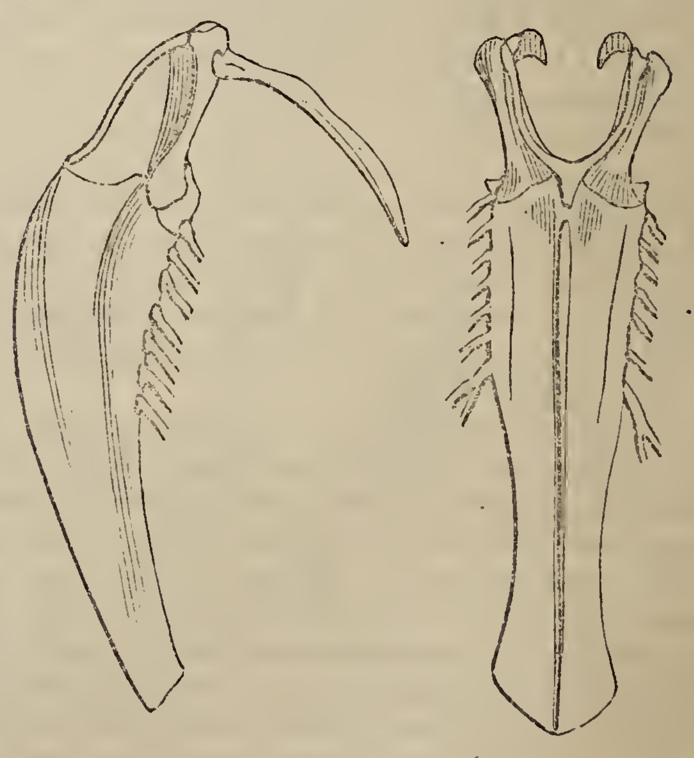
It will be perceived that, in those birds, there is a considerable deviation from the usual means of supporting the shoulder. The coracoids are strong, they are well set as far as direction is concerned; but the smallness of the bases by which they are articulated gives them little stability in the vertical plane. They are, however, strongly tied to the shoulders by means of the large blade bones; and thus the support of the wing, or rather of the swimming flap, is thrown as much upon the muscles of the back, and through these as an elastic medium upon the spine, as upon the sternum.

As these birds use their imperfectly produced wings only in swimming, or in the leaping motion, in which there is no second effort of the wings in the air, and indeed little or no effort of them there at all, the body is never borne up by those appendages, and thus the organisation of greatest ease to the bird is that in which the upper and the under sides contribute equally to its support. In its ordinary habit of being in the water, indeed, it is pressed pretty equally by that fluid upon all sides; and therefore the greatest stability of the clavicle, which is the bone which resists the compressing force in the motion forward, is more stable by having its hold on the back by means of the large scapular. The clavicle is flattened, and placed with the edge forward, so that it presents to the water through which the bird moves the greatest stiffness which could be obtained from the same portion of bone; and its articulation at the shoulder is such that, when there is a strain on the middle part of it, it tends to pull the scapular forwards. This the broad scapular resists, and it is aided in its resistance by the anterior lateral processes of the sternum, while the equal supports which the flap of wing has from above and from below, enable it to act with equal force in its upward and its downward stroke, and thus perform with more efficiency its fin-like function. The birds of this group are slow and unwieldy, with little capacity of motion either in the air or upon land; but their organisation is as admirably fitted to their habit as that of any other birds; and they are curious, as forming the last link between the birds which, as a class, are more typically inhabitants of the air, and those vertebrated animals which are permanently dwellers in the waters, and cannot carry on the process of respiration in the pure air.

Among the long-legged or long-winged birds which find their food near the waters, in fresh water or in the sea, there is a resemblance in the sternum, but there is also a gradation which may be traced, from the agami, which may be considered as among the least aquatic of the whole, to the cormorants and gannets, and perhaps even to the gulls and terns. This sternal structure does not of course, in birds of such varied forms and habits, accord with the classification which is usually made of them on the structure of their bills and feet; but they all agree in being, to a very considerable extent, air-birds; though none of them, the genus lestris excepted, find their food in the air on the wing; and these do not find their own prey in that element, but live upon the food of other birds, which they make these disgorge from their stomachs, and catch it ere it falls. Gulls and terns are the races which are chiefly robbed in this manner, and so prone are they to offer this sort of boon or bribe to real or supposed enemies, that, even in a state of confinement, they will disgorge the contents of their stomachs at the sight of an eagle, or any other formidable rapacious bird. Even the petrels, whose habits are too much seaward for encountering predatory or even plundering birds, have this disposition; for when they are compelled, as they often are during severe weather, to alight on the decks or rigging of ships, they instantly make a votive offering of the quantity of oil with which their stomachs are loaded.

The habits of long-legged birds are so diversified—they are so much on the land in certain cases, and on the waters or by the sides of them in others—that it is not easy to select any species as a fair average of the whole; but they follow the general law in having the sternum short in proportion as they are more on the wing, having that bone more elongated, and narrower in proportion, as they are more of walking birds in open places which have not water, and in having the posterior part more divided by notches, in proportion as they are more aquatic.

Sternum of the agami. In their general characters these birds are certainly not a little anomalous; and though they are usually classed with the cranes, to which they have scarcely any other point of resemblance than a long neck, which after all is not a crane neck, but one fully as like those of the ostrich family, they partake of the characters and some of the habits of gallinaceous birds,—or rather they partake so equally of the characters of many races, and so little of those of any one, that in nature they stand alone and distinct, whatever may be the place assigned to them in any system. It is also not a little remarkable, that the sternum of these birds is as unique as their character; and this very clearly shows that no classification of birds can be either natural or valuable as an index to their history, of which the sternal apparatus does not form a considerable and even the leading part. This is what we might expect; because when we carry our analysis as far as it can rationally be carried, that is to the bones which give the entire structure its form and its leading characters, we find that it is by the sternum, and those attached bones the coracoids, which are never wanting in a bird, be its habit what it may, and never present in any other animal, that we determine a bird to be a bird and nothing else. The following figures represent the sternal apparatus of the agami.



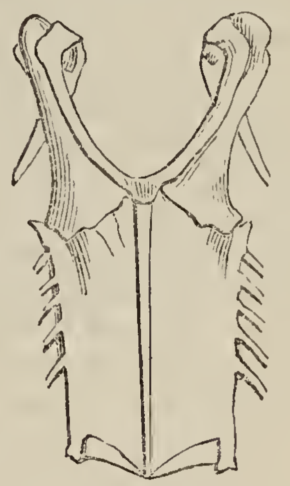
Agami.

Upon examining these representations, it will be found that the bird to which they have the greatest resemblance is the gallinule; that the general form of the sternum is nearly the same; but that as the gallinule is a much more aquatic bird than the agami, its sternum possesses two very elongated lateral processes, while that of the agami is entire. The ribs are also more numerous in the agami, and occupy a greater portion of the length of the sternum, and though the scapular is not so long, it is broader, has a slight approximation in form to that of the penguin, and is strongly articulated to the head of the coracoid, while that bone, though well set as to the resisting of cross strains, is rather loose in its articulation with the sternum as seen laterally. The furcal bone is much more slender than in the gallinule, and it has a process at the junction of its branches directed toward the keel of the sternum as in the gallinidæ, whereas that of the gallinule has only a small tubercle on the upper side at that point. The whole line of the furcal bone of the gallinule, when viewed laterally, presents an arch, though a flattened one, to the front; while that of the agami, though slightly convex near the articulation with the other bones at the shoulder, is concave to the front in the part next the sternum. Throughout its whole length, this bone is remarkably slender and feeble as compared with the sternum, the coracoids, and the scapulars; and on this account the agami may perhaps be regarded as the feeblest winged of birds which have the clavicles united and can use the wings in flight. The great elongation backwards of the sternum makes a very marked difference between this bird and the ostriches, in which this bone, instead of being long, narrow, and but little curved, as it is in this case, is short, broad, and very convex on the under or external surface. The habit of the bird corresponds; for while the ostrich family, in whatever part of the world they reside, are found on dry if not parched and naked pastures, the agami is found native in richer places, near the perennial waters, but on the verge of the tall aquatic herbage rather than in the middle of it. The agami is thus intermediate in its locality between the ostrich and the gallinules, and other macrodactylic birds; and it is not a little remarkable that its sternal bone partakes of the undivided character of that of the one race, and the elongated one of the other.

Sterna of the crane family. The cranes and the herons are not only found in places bearing considerable resemblance to each other, but some of the species are externally so much alike that they have been very generally considered as forming one tribe and sometimes only one genus.

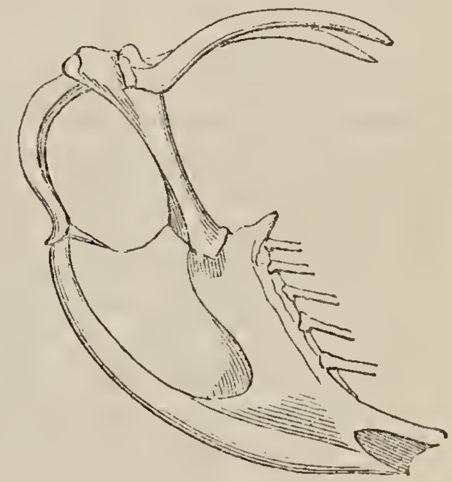
The grand distinction between the cranes and the herons, whether we consider them as distinct groups or merely as genera (and the distinction is perhaps broad enough to amount to the former), is that the cranes have much more of a landward character than the herons, and they are also much more discursive and migratory, though from their habit of fishing or otherwise feeding in the shallows of the waters, herons are also necessarily migrant in those parts of the world which are alternately flooded by water and parched by drought.

The sternum of the cranes is of moderate length, rather narrow, very little hollowed on the upper surface, and of nearly equal breadth throughout its whole extent. The sternal crest is large in proportion to the whole extent of the bone; arched on the under side for the greater part of its length, but slightly concave toward the posterior extremity; and in some of the species it contains a large cavity in which a flexure of the windpipe is lodged, as is also the case in some of those long-necked swimming birds which seek their food with the head immersed in water. The angle of the crest advances considerably in front, is rounded, and, in the true cranes, and some other species, united to the central part of the clavicle. Seen in profile, the sides of the sternum appear concave; and in the rear it is divided by two triangular notches, which form the posterior angles into two processes which extend a little, but not much, beyond the central part. The coracoids are short, strong, and much enlarged on their posterior sides. The clavicle is open, though but slightly arched in the plane of the opening. It is much enlarged toward the shoulder-joints, and much more arched toward the front than laterally. The blade bones are long, flat, and slightly bent, but not so large in proportion as in the agami. The following figures of the sternum of the white stork, on a scale of half the natural size, may be considered as an average specimen.



White Stork.

Profile of the same bone on the same scale.



White Stork.

On examining this sternal apparatus it will be seen that though the keel is well developed, and the shoulder also moderately firm for flight, yet that the extent of the scapular, the arching toward the front of the clavicle, and the union of that bone with the angle of the sternal keel, throw a portion of the support upon the back and thence to the legs, which in all the species are well adapted for walking. Still, though these birds cannot be considered as possessing either very swift or very ready wings, they have all considerable power of continuance on their flight. They are also light birds in proportion to the extent of their wings, and therefore they fly high on their long flights; and, as is the case with the true grallidæ or wading birds, they fly with the feet backwards, and use these in steering their course, in supplement to the tail, which is, generally speaking, short.

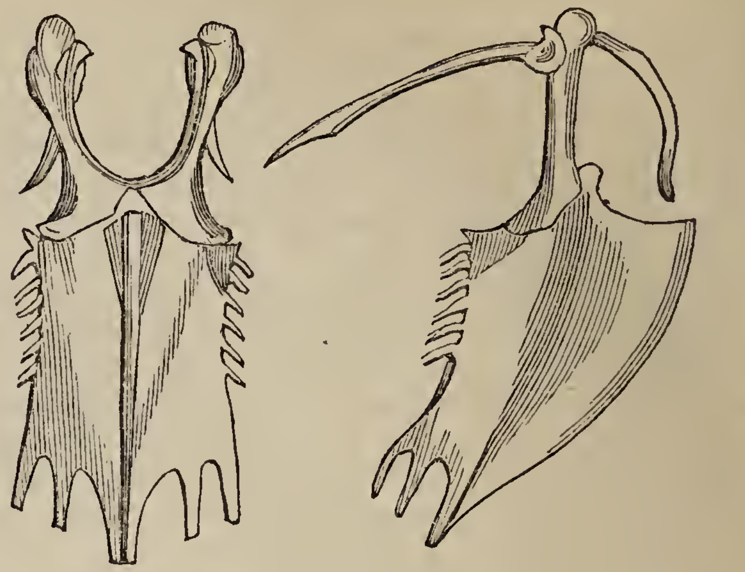
The example above given must be considered not as an average of the crane family, as the storks do not strictly belong either to the cranes or to the herons, though they resemble both; but it is a tolerable average of the sternal apparatus of Cuvier's sub-order cultrirostres.

Intermediate between these and the grallidæ, which include the pressirostres and longirostres of Cuvier, which have much less difference in their haunts and style of flight, and consequently in their sternal apparatus, than in their bills, there are some species or genera, which require distinct notice. These are the ibises and the spoon-bills, which are more discursive than almost any members of the crane or heron families. The birds which may be considered as forming this group do not suit well with the genera with which they are usually classed according to the bill. That of the spoon-bills is not in the coulter or knife-shape, as may be seen by looking back at a sketch of it given on a former page; while that of the ibis, though it resembles in shape the bill of the curlew, and certainly deserves the epithet "long," is not of the same texture with the generality of those bills of which length has been taken as the distinguishing character. The genus tantalus, which resembles ibis in many particulars, has the bill straight; and there are various other genera included in the cultrirostres of Cuvier which have bills so totally different from each other that they cannot properly be brought into one group from the structure of that organ.

With regard to the habits of these birds, and more especially those of the genus ibis, it may not be irrelevant to mention that they have long got credit for being destroyers of poisonous serpents, and according to the story were, on this account, deified by the Egyptians; but this habit is very doubtful, beetles are more likely food for them, and poisonous serpents are not numerous in their haunts.

The general habits of the ibis, tantalus, and spoon-bill so much resemble each other, and they are all so perfectly similar in their sternal apparatus, that they belong perhaps more naturally to the same group than almost any other genera of birds. Their sternum is short, broad, and deep, with the keel much produced, and altogether indicating a capacity of powerful and continued flight. It is pointed anteriorly so as to afford firm basis to the coracoids. The keel is a little concave anteriorly, but convex on its under side. It is nearly of the same breadth throughout; bears six ribs on each side, the sides being concave when viewed laterally, and the posterior portion is divided by two notches of moderate depth towards each angle, the central process being longer and much stiffer than the lateral ones. The coracoids are short, strong, well-set, much enlarged both at their bases and at their heads; and the clavicle forms a perfect semi-ellipse, thickened at the shoulder-joints, and generally united to the angle of the sternum. The scapular is small-pointed at its extremity, and very slight and curved. The strength of this apparatus is obviously directed towards, or concentrated on, the shoulder-joint; while the comparative shortness of the sternum, and the flexibility of its posterior angles in consequence of the notches, give free scope for the motion of the legs, which are in all the species long and well adapted for walking.

The following half-sized figures of the sternal apparatus of the glossy ibis (*falcinellus*), which sometimes, though rarely, makes a dash into this country on its migrations, will serve as an example of those very singular birds.



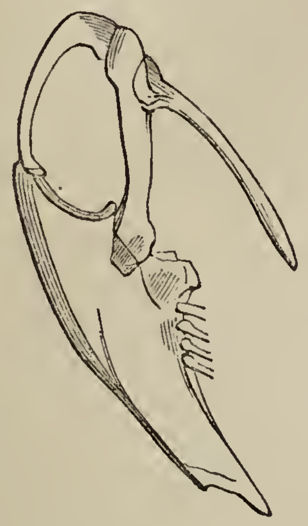
Glossy Ibis.

Sterna of the Totipalmæ. These birds, which may perhaps be considered as, in habit, taking up the system after the herons, have considerable diversity in their haunts and modes of life. Some, as the albatross, are almost habitually on the wing over the sea, while others, as the cormorants, are less discursive, resort sometimes to the fresh waters, and occasionally perch upon trees; but they all agree in finding the greater part, if not the whole, of their food in the waters, and descending upon it on the wing, instead of getting it by wading or by walking, as is the case with the groups last mentioned. Hence, in all the varieties, they have a sternum well adapted for flight; but it also combines another character, which will be better understood after examining the following figures of the sternal apparatus of the common cormorant, which are given of half the lineal dimensions of nature.

Cormorant.

It is however in the next figure, which is the profile on the same scale, that the peculiar modification of the sternum of these birds is best seen.

Upon examining the following profile figure, it will be found that this bone presents a still more powerfully-resisting arch to the front than that formerly alluded to in the divers. The anterior edge of the keel, the coracoid, and the clavicle, form a complete egg-shaped structure, with its narrow end in the head of the last bone, where it is greatly increased in breadth, and consequently in firmness of resistance; while, from the manner in which the head of this bone is formed, any strain given upon the more advanced part of it is divided among the coracoids, the scapulars, and the keel of the sternum, though the greater part of it goes in the direction of the first of these. They are well adapted, both from their form and the mode of their attachment to the sternum, for resisting the strain of a pressure from the front. The basal parts are very large, and so are the heads, with which the branches of the clavicle are in all cases firmly united, and in some they are soldered into one continuous bone.



Profile of Cormorant.

And there is no waste of strength in the firmness against a pressure from the front which is thus given to the shoulders of these birds; nor is the advancement of the clavicle in front of the shoulder-joint, or the strength which it receives there from its increased curvature and breadth, and its intimate union with the head of the coracoid, without an object and use in the economy of the bird.

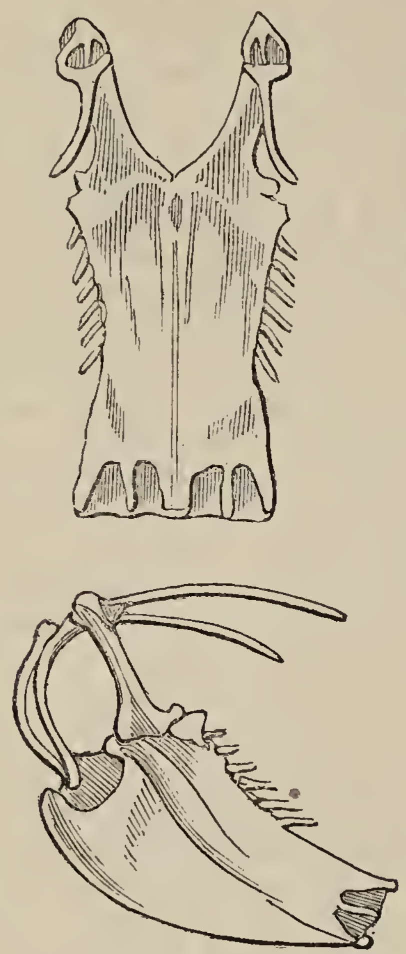
These birds do not make way with their whole body in the water, as is the habit of the divers; but they take the water with much more force, and therefore with a greater shock upon their bodies. Almost all of them plunge headlong on their prey in the water, and some of them do so from a great height—a height from which if even the strongest of the mammalia were to fall on their feet upon the water, they would be in danger of dislocating their joints, or even breaking their bones. All who are in any way familiar with the water must be aware how dangerous it is to descend into that liquid, even from an inconsiderable height, in any other way than head foremost, and especially how very hazardous it is to jump into it from a greater height with the legs apart from each other. Many of the birds of this tribe descend from heights and with velocities which, notwithstanding their feathery covering and the yielding nature of the fluid on which they descend, would, if its effect came as a cross strain, break the stoutest bone in their bodies. The bird from its form penetrates the water easily, and the articulations of the neck are so many, and so free in their motions, that any shock which the head may receive by the plunge is so divided among them as not to occasion the least concussion of the contents of the skull. Thus the parts which come into the severest contact with the water are the shoulders: and this is met by the strong and comparatively narrow parts of the arches in the direction of the vertical plane. And, upon examining the front view of the sternum, it will be found that, besides the hold which the scapulars have on the back and the stiffness given by the clavicle, the great breadth of the coracoids at their bases, and the form of the lines of their union with the sternum, afford a very firm base in the cross direction.

The more typical of these birds are not very rapid fliers, but many of them are much on the wing; and they fly by powerful strokes rather than quickly-repeated ones. Hence they have the sternum broad, and the fibres of the pectoral muscles long, so that, on the principle formerly explained while noticing the wings of the anisodactyli, these wings sweep over large arches and with much power, though slowly as compared with birds that have the sternum narrower and the muscular fibres shorter.

There is another advantage which this large sweep but slow motion of the wing has over a shorter and quicker one: the wind has much less effect either in fatiguing the bird or in drifting it to leeward; and hence we find that most sea birds have this long and swinging flight, whether they belong to this family or not. Those of this family are of course not the best fliers among sea birds, as their sternal apparatus is not formed wholly for flight, but for that and resisting the plunge jointly; and as each of these requires a different structure, each of them must, to some extent at least, weaken the other.

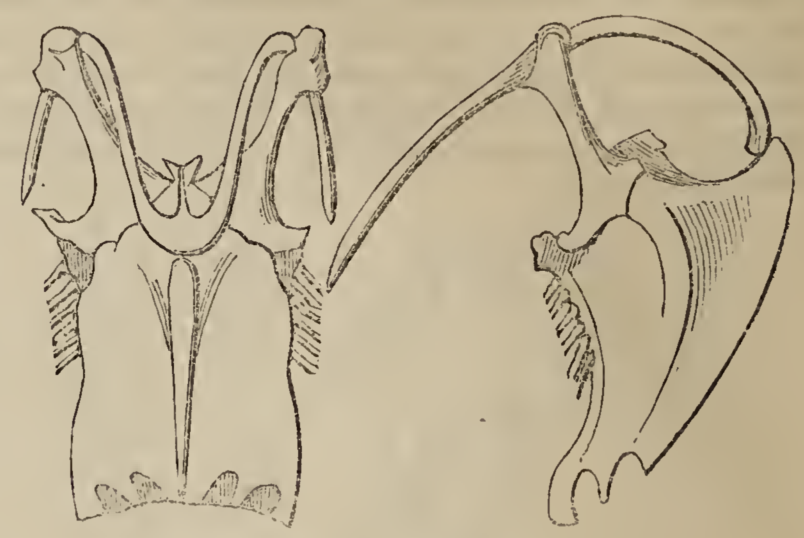
Sterna of the Longipennes. These have some resemblance to those of the former tribe, and also to those of the grallidæ, as might be expected from the birds partaking in part of the habits of both; but they have also habits which are more peculiarly their own, and the sternal apparatus is modified to accord with these. Not only this, but as there is a gradation from the gulls, which feed on the wing, and also, in walking on the shore, to the petrels, which are more exclusively seaward, and walk little: but there are so many modifications of the sternal apparatus, that no single bird can be selected as an average type of the whole. We shall therefore select two specimens: the laughing gull as nearly an average of the more landward subdivision, and the puffin petrel as nearly an average of the more seaward.

The sterna of the skuas, gulls, and terns, are in their general form intermediate between those of the entire footed birds and of the waders. They are rather longer and not quite so broad in proportion as those of the former; but broader and less elongated than those of the latter. The keel also, though well developed, is not so high in proportion to the width of the sternum. From this structure it follows that the motion of their wings, though more powerful, must be slower than that of the waders; and the wing itself is longer in its bones and its feathers, as well as in those muscles which put it in motion. This structure accords with the general habit, which is that of skimming about with smooth and moderately swift wing, and culling their food from the crests of the waves, or from substances cast up by the waters and left upon the strand. The keel of the sternum is deeply concave in front, with the angle much rounded; and the posterior part, which is nearly square at the end, is divided more or less deeply by four notches, the two middle ones of which are larger in some of the species, and the two lateral in some of the others. The posterior, or carrying part, of the sternum is rather broader than the middle part to which the ribs, which are six or seven, are attached; and the lateral processes extend on the flanks without any bending inwards. The coracoids are strong and well set, the clavicle wide, convex anteriorly on the upper parts of its branches, but recurved at their junction, and always united to the keel of the sternum. The scapulars are scithe-shaped, rather long, and of moderate breadth. From its structure, this sternal apparatus indicates considerable power of flight, and also strength for resisting pressure on the anterior part, though in this last respect it is much inferior to that of the entire footed birds; and in both it is very inferior to that of the petrels. The following figures of the sternum of the laughing gull, and more especially the lower one which represents the profile, will illustrate this structure.



Laughing Gull.

The sternal apparatus of the petrels is much better formed both for flight and for resistance of pressure against the front. It is short and broad, rather narrower in the middle than towards the extremities, very concave on the upper surface, and consequently convex on the under. The keel much produced, extending with some elevation to the posterior extremity of the sternum, but much more elevated in front, convex in its under outline, and concave in the front one; the angle much produced, rounded, and supporting the clavicle, which is enlarged at the junction of its branches. The lateral processes of the sternum are well produced, the grooves deep, and the coracoids firmly attached by large bases. The sides concave upwards, carrying six ribs. The posterior edges differing in different genera, being entire in the storm-petrels, having a large notch on each side in the albatross, and two small ones on each side in most of the others. The coracoids are strong in their whole length, but remarkable for the extent of their bases and the largeness of their heads, from the first of which structures they form a perfect arch in the lateral directions, even without the assistance of the clavicle. But the clavicle is also strong, and capable from its curvature of offering a powerful resistance to any strain, whether lateral or from the front. The scapular is slender, very slightly curved downwards, and continued in the same curve with the upper part of the clavicle. This is indeed one of the firmest shoulders which occurs in the whole class; and, as will be seen from the profile in the following figure, the keel of the sternum, the coracoid, and the scapular form a very perfect ellipse, extending to about three-fourths of an entire circumference.



Puffin Petrel, half the size of nature.

Though the sternal apparatus of all these birds possesses great power, that power does not indicate an equal capacity of flight in the whole. The differences as connected with flying are chiefly found in the posterior edge; and as we have them in birds which have the rest of their sternal apparatus very much alike, and have the habit of flying connected with each, we are thereby better enabled to judge of the difference between entire and partially divided sternums than if we had the means of comparing these only in birds which less resembled each other in other respects. The different species of storm petrels which have the sternum entire, and consequently the firmest origin for their pectoral muscles, are among the most continued and excursive fliers of which we have any knowledge. The wide sea is their pasture, and, be its extent what it may, they range from shore to shore; now rushing at a moderate height through the air, with light wing and with great velocity; again skimming close to the surface, so that the points of their wings tip the water at every stroke; and yet again running along the water, with expanded wings, which, though they seldom move, float them so buoyantly that they just touch the water with the points of their webs, and thus paddle swiftly along, collecting on the feathers of their breasts that floating pellicle of oil which forms no inconsiderable portion of their food, and which, when they have wearied themselves in skimming, they lean on the wave, and remove with the bill at their leisure.

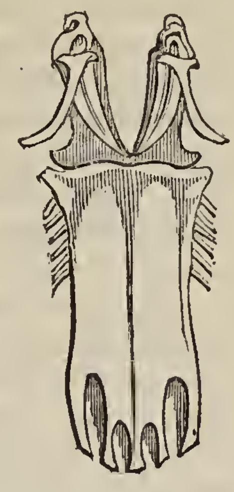
The albatross, which, though a very long-winged bird, has a more heavy and gull-like flight than the storm petrels, has, as already noticed, one notch in each posterior angle of the sternum, by means of which those parts of the bone are rendered feebler. These birds are scavengers for larger matters rather than skimmers of the oil of the sea, like the preceding genus, but they are wide ranging scavengers, and, when they are once on the wing, miles of ocean are of little consequence to them in their range.

The common petrels, and other birds which have four notches in the posterior part of the sternum, are inferior to the others both in the style and the rapidity of their flight, and a connexion may be traced perhaps as naturally from them through the puffins and auks to the wingless birds, as that which is traceable from the divers. The whole of this family may, however, be considered as the most pelagic of all birds, because, though there are others which are much more in the water, or on its surface, there are none which have equal power of wing, or are capable of extending their excursions so far from the land.

Sternum of the Grallidæ. Though the birds which form this order, even when restricted by leaving out those groups which have been already mentioned in the course of these observations, differ very much in the structure of their bills, yet there is far less diversity in their sternal apparatus than the consideration of the bills, as their chief character, would lead us to suppose. But, when we consider that none of them are habitual fliers, that they fly only for change of place, and that their flight is generally taken by rather short and swiftly-moving wings, we might be prepared to find that agreement which there is in the sternal apparatus.

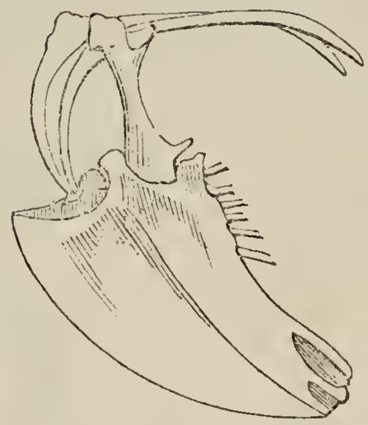
It suits the walking and the wading habits of those birds, and also the tangled herbage through which many of them have to make their way, to have the body narrow in proportion to its depth. The sternum is in consequence long, and rather narrow, a little enlarged towards the posterior portion, and divided there by four notches of considerable depth, the lateral ones generally the deepest; the processes between the notches feeble, but generally enlarged at their extremities, so as to form the posterior outline of the sternum into a convex curve. The crest is generally large, convex below, concave in front, with the angle terminating in a process; lateral processes not nearly so much developed as in the petrel family; the basis of the coracoids not nearly so large, and their attachment to the sternum not so firm; the coracoids are, however, short, stout, and considerably enlarged at the heads, but their position is too parallel to each other, and too much in the general line of the sternum, for giving that stability to the shoulder-joint which is essential to long-continued and rapid flight. The clavicle is elongated, curved forward at the middle of its branches, and directed at their junction throughout the middle part of the anterior edge of the keel, and they are enlarged in breadth toward their junction with the coracoids. The scapulars are rather large, flat, straight for great part of their length, but bent downwards toward the points, so as to have a firm embedment on the back.

In this latter part of the structure it will be perceived that those birds have much more the character of walking or ground birds, than those of the preceding group, or indeed than any of the water birds which are much in the habit of using the wing, even though not so good fliers for a short time as some of the wading birds are. The enlargement of the clavicle toward the shoulder-joints, the large heads of the coracoids, and especially the increased size and peculiar form of the scapular, together with the comparatively loose attachment of the coracoids to the sternum, show that the strength of the shoulder in those birds is not wholly, or even chiefly, based upon the sternum, but that great part of it is connected with the back through the produced shoulder-bone, and being connected with the back, it is, by means of that, referred to the legs for support. This is not the case so exclusively as in the wingless birds, because all the grallidæ can fly occasionally, most of them can fly well, though their flights are rather short, and the wings of them all are ready in turning and wheeling; but still a careful examination of their sternal apparatus, as combining the elements of walking and the elements of flight, would probably be found a much better ground of classification than any to which systematists have hitherto resorted. We shall give the sternal apparatus of the lapwing, which is a tolerably good runner, and also a ready flier, as nearly an average specimen of the whole.



Lapwing.

The following cut represents the sternal apparatus of the same bird in profile, and both cuts are of the natural size:



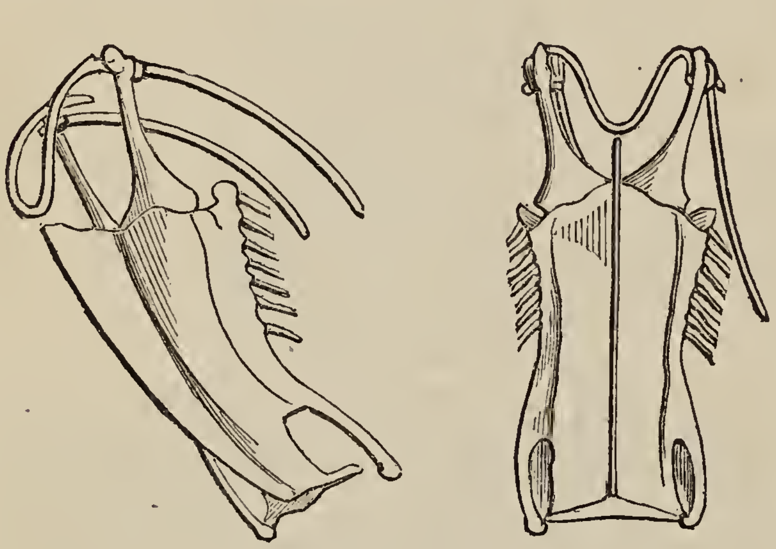
Profile of the Lapwing.

Sterna of the Lamellirostres. As in so far as their aquatic habit is concerned, the sternal apparatus of all these birds is adapted for the bearing up of their bodies while they float upon the water, there is, independently of their different degrees of adaptation for flight, a general character which runs through the whole order. The largest diameter of the body is reversed as compared with that of the grallidæ. These have it vertical, so that they may the more easily make their way among the herbage, and also present the least resistance to the air, and give the greatest scope to the legs in walking, wading, or running. But the flat-billed birds have the body more or less flattened horizontally, as well as the bill, by which means they present to the water a large base in proportion to their weight, and thus swim more lightly. The sternum is elongated, and also increased in width, so as to accommodate itself to this form of the body, and upon the average it is so placed that the centre of gravity of the bird is very nearly over its centre of resistance, so that all parts of it are pressed upon with nearly equal force as the bird floats along.

The habit of floating along the water is, however, in the different genera and species of these birds, combined with so many modifications of other habits, that it is subject to numerous though slight variations. Those habits are greater or less degrees of flying, walking, and diving; and, from what has been already said respecting birds of which each of these is the principal habit, it will readily be understood, without repetition, how far each must modify the swimming or floating character, which is the principal one of this class.

They have the sternum elongated, varying in breadth, narrower in the middle than at the extremities. The sternal keel is well developed, but usually lower than the width of half the sternum. The lower edge of the keel is sometimes convex, sometimes straight, and the anterior one generally concave, and in some of the species there is a cavity at the base of the crest, in which a duplicature of the trachea is lodged. The coracoids are never very long; they are large at their bases, and rather firmly attached to the sternum.

There are seven or eight ribs (in some cases nine) on each side of the sternum, and the posterior part of that bone is generally divided by notches, though the heads of the processes are so much produced as nearly to meet each other. The clavicle is of moderate length, and well arched, and the shoulder bones rather slender, and arched through the whole extent. The general character is that of having the bones of the shoulder much more exclusively supported from the sternum than is the case in the wading birds. The following figures of the sternal apparatus of the nyroca pochard, or white-eyed duck, may be taken as a specimen.



White-eyed Pochard.

In these sections we have taken a rapid glance at the general structure of birds, and those characters which distinguish them from the other classes of vertebrated animals; and we have entered rather more minutely into those peculiarities of their three grand structures, the bill, the feet, and the wings, upon which, singly or jointly, the leading differences of their habits in a great measure depend. It would now remain to investigate their relations to the rest of nature in locality and in season; but as this part of the subject involves the knowledge also of the natural history of localities and of seasons, it is of too general a nature for being made a specific portion of the natural history of birds, though they cannot be known to the full extent without a knowledge of it, neither can it be understood to the full extent without a knowledge of them. Nature is one workmanship of one Author, and he who wishes to know any single part well, must lay the foundation in some general knowledge of the whole.

BIRDS OF PARADISE (*Paradisea*). A genus of birds belonging to the sub-order or group *Conirostres*, of Cuvier's order *Passerus;* and, from the manner of their feeding, to the natural order *Omnivora.* Their generic characters are: The bill of moderate size, four-sided, straight in its general line, but arched in the culmen, and slightly hooked at the tip of the upper mandible, in which there is either no notch, or a mere rudiment; lower mandible straight, and the tomia closing for the whole length of the bill; the nostrils basal and lateral, open, but concealed among the feathers at the base of the bill, which is without any naked skin. The tarsi and toes are stout; the latter, three to the front and one behind; the middle toe shorter than the tarsus, the outer united to it at its base, and the inner joined half the length of the first phalanx, the hind toe larger and stronger than the others. The first five quills of the wings are nearly of equal length, and the sixth or seventh usually the longest.

As the skins of these birds, deprived of the feet, the wings, and the tail, have long formed an article of export from those countries in which they are found, they were known in Europe in that mutilated state long before any of them had been seen alive, or their manners were at all known. In this state they do not bear much resemblance to an ordinary bird, at least in any part except the bill, head, neck, and shoulders, for the rest of the body is hidden by supplemental feathers issuing from the flanks, the shoulders, or both, which are so loose, light, and airy toward their points, that they bear (in as far as that which is *solid* matter, however finely divided, can have a resemblance to *light*) some resemblance to the tails of comets. The feathers, which are not thus produced, especially those about the insertion of the upper mandible, are remarkable for their velvety texture, and the beauty of their metallic reflections; and with this fineness of gloss, and richness of tint and texture in the part which was like a bird, and the substitution of these curiously produced feathers, in place of all the ordinary organs of locomotion, either on the ground or in the air, it was perhaps not much to be wondered at, in those early days, when foreign lands were new and little known, and romance and marvel were the order of the time, that these birds should have been supposed to whisk about like meteors in the bright beams of the equinoctial sun, without the usual attributes of wings, or that they should have been supposed to dwell in the air, and live upon the nectar of those flowers, which, in the climates where the birds are native, twine their beautiful garlands and festoons to the very tops of the trees.

It was from this supposed aerial habitation, and all but etherial food, that these creatures obtained their somewhat inappropriate name of birds of paradise; and their elevation above the dull earth, and abstinence from all the more gross ways of life which its more humble tenants require, have been the subject of many an eloquent and elaborate descant.

But it is provoking to the inventors of those fancy-wrought marvels of nature, who, like the eye of the sleepless, people the dark with phantoms of their own creation, and are enabled to do so, just because it is the dark, that truth comes with her torch, and they vanish; and it is sometimes still more provoking, that the torch is not sufficient to reveal those real wonders of nature which were concealed by the darkness which admitted the fictitious ones; and thus we are reduced to that vexatious twilight, which is too light for fancy, and too dark for fact. This is that "little learning" which, on all subjects, but especially in natural history, is truly a "dangerous thing." It resembles, in the progress of knowledge, that stage in the life of man, in which the toy of the child has ceased to please, and the mind is yet all too inexperienced for "standing up against the wind of the world's temptation:" it is the time of peril—that at which knowledge stands most in jeopardy of error, and character and happiness of ruin.

The false charm of these birds has been dispelled: they have feet and wings, just as the most humble and despised of our common birds have; and so far from feeding upon nectar, they feed on the pulpy and farinaceous parts of fruits, upon worms and insects, and the carrion of larger animals; and it is probable that they rob the nests of the smaller birds, and even strike the birds themselves on the head, and eat their flesh; at least, all this would accord with their analogies as omnivorous birds, and birds of bold and pugnacious character; and these facts have, in part, been established by observation. The truth is, that they more nearly resemble, in their habits, our magpies and jays than they do any other of our resident birds; and it will be borne in mind, that these are among the gayest of our birds both in the tints and the metallic glosses of their plumage.

Still, though these birds have lost all the ethereal and fairy-land part of their character, their real interest has not been thereby diminished. In human exhibitions, we despise the puppet when we discover the string; and the picture, which appeared fine at a distance, becomes a daub when we examine it too closely. But so different is it with nature, that we never can see enough of the moving power, or approach sufficiently near for finding out all the beauty. Hence, whatever may be the case in human character and conduct, the romance of nature is always tame and tiring as compared with the reality.

It is so in the case of the birds of paradise, and we cannot be too thankful to the naturalists, who have delivered those children of the sun from the bondage of fable, and brought them to the light and the freedom of science. They are singularly formed; they inhabit a very peculiar portion of the globe; and we may rest assured, that when once we have fully found it out, they have a singular tale to tell.

New Guinea may be considered as the head-quarters of the genus, and they range seasonally between it and the smaller isles which lie in its vicinity. Their feet (which, by the way, require to be more carefully examined as to the articulation of the toes) are not ground feet, but perching ones; and though they live in the depth of the forests, they do not, in fine weather at least, hide themselves in the covert of the twigs and leaves, but perch on the summits of the loftiest trees, being thus the highest dwellers in the forest. Their flight is that of the tribe with which their habits more immediately connect them. It is undulating and jerky, and not smooth and continuous. Their wings are short and broad, and probably their curiously produced feathers act in some sort as a parachute to render their settlement on their elevated perch more easy. It is obviously, however, not a plumage for entering into the tangled parts of the trees, and contending with the twigs and other interruptions, as may be seen from the four species represented on the plate "Birds of Paradise;" to the two of which that are represented on the wing Landseer has contrived to give more buoyancy, and even appearance of upward motion, than perhaps the burin alone ever previously imparted to the representation of a bird. They put one in mind of the floating figures in the *chefs-d'œuvre* of Raffaelle, which, all wingless as they are, ride more lightly by the magic of the master's hand than the compositions which less skilful and scientific artists endeavour to bear up upon those incongruous, and therefore unseemly appendages. These two birds are quite a study; but they probably may not strike the unpractised eye so much as inferior productions, which first attract the attention because they are out of nature, and then please mechanical taste by that handling of the tool which is feeble and lifeless in proportion as it labours to be fine. We seldom need to invite attention to what comes from this artist, and such would be a work of supererogation; but, in the present case, we must appeal to the picture to help us out: the flight of a bird of paradise is, from the peculiar form and lightness of those produced supplemental feathers, so unlike that of any bird with which we are familiar in Britain, that to give a verbal description of it would be no successful matter; and we feel satisfaction in being saved from the chance of failure, by bidding the reader turn to the plate, and see the birds on the wing.

We know not enough of the habits of these birds to be enabled to say what specific purpose their very singular plumage answers in their economy; but we know that those herons which have feathers somewhat similarly produced, migrate with the seasons, and follow the line of the waters, leaving those districts in which the brooks and pools seasonally become dry, and the rivers low. We know also that the islands in which birds of paradise have hitherto been found, are subject to alternations of rain and drought, though not so violent nor of so long continuance as in the more extended lands within the tropics. Farther, we know that in the tropical countries the fervent heat of the rainless period, comes at last to have all the effects of a winter, in the suspension of animal and vegetable action. The depth of the tangled forest is, indeed, in some measure, proof against the heat, and the creatures which inhabit and feed lower down and more in the shade than the birds of paradise, can still obtain their subsistence. But though the smooth leaf reflects off much of the heat, and does not fall or wither, the vegetable action of the tree, at least in the exposed part of it, is suspended; and when the vegetable action of trees is suspended, the feeding of insects upon them is suspended also. In our gardens and groves, it is the young and growing leaf on which the caterpillar feeds; and when the hardened leaves of autumn are consumed, they are consumed not by animals of any kind, but by the smaller fungi. We are not to suppose that the leaves of tropical trees are, in the dry season, consumed in the same way, for humidity is as necessary to the growth of this smaller vegetation as it is to that of the larger; but if the leaves are less fit for the production of fungi than with us, much more must they be less fit for the food of leaf insects; and though there are tropical insects which are wholesale consumers of decayed or decaying trees, they attack them from the ground, consume the wood rather than the bark, are not found on those parts of the trees where the birds of paradise reside, and therefore they cannot be considered as forming even a part of the food of these birds.

Thus, as one part of those countries in which they have their haunts becomes parched, the birds of paradise must remove to another, just in the same manner as the lighter herons which have similarly produced feathers, must flit along the courses of the streams as the drought invades their dwellings at particular parts of them; and we shall see presently that the produced feathers, besides enabling the birds to ride more easily and descend more softly on their shorter excursions, in consequence of the hold which their countless flocculi take of the air, assist the birds in finding their way to those other places where there is food for them.

At those places where the earth and the upper part of the forest are parched, and the ardour of the unclouded sun continues to beat, there is a constant rarefaction and consequent ascent of the whole mass of the atmosphere; and in consequence of this the winds from the more humid surfaces must blow toward those parched places with velocities proportional to the differences between the one and the other. It is this which produces the seasonal winds of the tropical countries; and it is this, acted on by the changing declination of the sun which produces the changing monsoons or alternations of the tropical seasons: and here we have an instance of that beautiful arrangement in nature in which, from the motion of a planet in its orbit, to the action of an insect or a microscopic fungus upon a leaf, what seem to us to be the aberrations of nature, all contain in themselves the means of their own correction and reversal when they have reached their limit, which proves so clearly that the wisdom of design which is in nature is infinite.

This, when it arises naturally from the immediate subject of our contemplation, as it unquestionably does in the present instance, is always worthy of something more than a mere passing expression of wonder. For, as is the case with the Creator himself, space and time are so small impediments in the way of those laws which he has given to his works, that we may fetch from the most distant point of observable space, or the remotest one of known history, an illustration of that which is before us at the moment. As the earth rolls along from its perihelium or point nearest to the sun, its motion along the elliptic path contains the element, by means of which it shall again approach nearer to that luminary; and in like manner its approach as it rolls onward from the point of aphelion, contains in it the element by means of which it shall again recede. It is so with the different seasons in all regions of the globe, and it is so with all those creatures which the seasons put into motion, whether the motion of life or that of migration. But to return to the birds of paradise.

When the forest which is their haunt at any particular time becomes parched, their food lessens, and they are compelled to be more on the wing in their search after it. But on which side soever there then happens to be a place more humid and more abounding in those creatures on which they feed, and which on this account is better suited to them for the time, there is a wind which blows from that side toward the place which is parched and heated; and as the action of that wind upon their flocculent feathers, turns them round on their centres of gravity like weathercocks, their heads are, as they fly, turned to the wind, and their progress is, of course, against its current. Their feathers must thus in so far assist the birds in finding out the direction of those places where they can feed; and though this is more remarkable in the case of birds of paradise than any other species, it is probable that many of the softer-feathered birds are also assisted in their tropical migrations by the set of the wind.

We must not suppose that this is too mechanical; and that the whole is performed by that to which we give the name of instinct; for of instinct we know, and can know nothing further than that it is a name which we give to those movements and actions of animals of which we can give no explanation. The word instinct, though we can hardly avoid using it, is never anything else than a subterfuge for our ignorance of the means by which any action of an animal is brought about; and we may rest assured that natural actions are no more performed without means in the unexplained cases than in the explained ones.

If we analyse the matter downward to the primary impulse of life in the creature, the mere fact of flying at all is just as much an instinct (that is, a matter of which we are ignorant) as the impulse of life which originates its flight in a particular direction at a particular season. The act of flying cannot be performed by the instinct alone, and indeed in all that part of the act which can be made matter of science, the instinct has no concern; we invariably find wings as the motive organs, and those wings are always fitted to the average style of flight which the habit of the bird renders necessary, with such perfect unity, that we would at first sight suppose that the one were the cause of the other. When, however, we examine them, we find that they both answer so equally either for the cause or the effect, that we are unable to select either of them without feeling that we are in error and have done injustice to the other; and therefore we either fall into absurdity and nonsense which bitterly, though secretly, reproves ourselves, as well as tends to mislead others, or we at once and frankly refer both to the same source, and confess that Maker who thus stands demonstrated in his works.

In the countries which these birds inhabit there are some races of insects which migrate on the wing *en masse*, but they float before the light winds and not against them; and the produced feathers by means of which the birds move slowly to windward, may thus enable them to meet their food, and seize it with the bill. Too little is, however, known relative to their manners for enabling us to speak with precision on this point; but those feathers which do not serve for clothing, or answer any of the ordinary purposes of flight, are well worthy of further investigation, as among the most curious parts in the structure of birds.

Night feeders, in all the races of birds with which we are well acquainted, are remarkable for having their feathers more soft and downy at the margins, and more loose in their whole texture and application, than day feeders. This holds good of many of the soft-plumaged birds, such as some genera of gallinidæ, which, though they find their food by the eye, and thus cannot find it in the dark, or even in the dim twilight, yet feed early in the morning and late in the evening, and squat and repose during the greater part of the day. Birds which have feathers thus formed are unable to contend with strong winds, and they are equally liable to injury from rain. This must apply in an especial manner to the birds of paradise. They are unable to contend with the blasts or endure the heavy rains which occur about the changes of the monsoons in those seas; and indeed these are often so violent that no bird can keep the air or remain on an exposed perch. Birds of paradise do not of course remain in the air at those times; but how or where they then find shelter has not been ascertained,—probably it is beneath the leaves of the palm family, some of which are so large that a single one suffices for a tent; and they are more tough and firm than many kinds of our ordinary timber. Palm trees are altogether admirably fitted for resisting the violence of the tropical storms, and for affording hold and shelter to any creatures that can cling to the thick tufts of leaves with which their tough but flexible stems are crowned. A palm trunk is, indeed, a realisation of the fable of "the bundle of rods." The longitudinal fibres, which extend from the root of the tree to its crown without any interruption from branches, or even any flexure, are so hard, firm, and elastic, that they have almost as much resemblance to wires of elastic metal as to the timber of any tree of temperate climates; and while they all have equal tension, they are embedded in a cellular tissue, which keeps them from pressing upon each other; and so renders the fracture of a very tall and slender stem, and therefore one which, according to our ordinary notions seems very feeble. next to impossible. The palm family are so numerous, and form so general and characteristic a feature in the scenery of tropical countries, that the knowledge of them is necessary to the proper understanding of tropical forest animals, whether mammalia or birds. But though closely connected with the history of birds of paradise, an account of those highly interesting trees would be out of place here. See the article Palms.

Notwithstanding that the old fable of the birds of paradise being footless, inhabiting the air only, feeding upon nectar and dew and even odours, and never coming to the ground, or resting upon any other support than the air until exhausted, incapable of the mysterious wingless flight, and at the point of death, has been exploded, there still hangs a good deal of mystery about their mode of flying; and they do fall, both on the earth and in the narrow seas across which their periodical migrations are taken, more frequently than any ordinary air-birds. They fly, as has has been stated, only with their heads to the wind, and as the produced feathers of the flanks entirely cover the closed wing when the bird is in a state of repose, the same feathers would keep down and entangle both wings if the bird were taken by the wind in the rear; and even when it attempts to come obliquely, or fly upon a wind as one would say, the windward wing gets entangled in these feathers and down the bird drops. If it falls in the water, it of course speedily perishes; and when it falls on the land, though its produced and flocculent feathers prevent it from receiving any injury, yet it has considerable difficulty in righting itself, and it cannot take the air again without getting upon a stone, a clod, or some other little eminence. In consequence of this it becomes an easy prey to the natives, in the same manner as the parrot tribe are easily taken when they miss their hold and tumble from their perches.

So far as is known, birds of paradise are the only species which are subject to lose their poise and command of themselves in the free air, and tumble down without any injury or exhaustion; and it is possible, and even likely, that this habit, which must have struck the first observers of them very forcibly, gave rise to that part of the fabulous account which represents them as tumbling to the earth in order to die there, but keeping the air at all other times. Here it may be proper to remark, that it behoves us to pause before we altogether discard as fabulous any of those accounts of natural productions, however ridiculous they may appear, and however they may involve contradictions or impossibilities, which have been made by persons actually visiting the places alluded to. Those fables are seldom if ever substantially inventions of the original narrators. In nine cases out of every ten it will be found that how much soever they may have blundered in the representation of it, there was a real foundation for the story; and thus the fable has its use as the means of guiding us to the reality; and the business of true science consists in setting these matters to rights, while that which would explode them altogether is the mere arrogance of ignorance. We have proofs of this in many instances; and among others in the giraffe and the unicorn; though the former animal is now well known; and not a doubt remains that the animal which has so long flourished in heraldic and other fanciful story, is the oryx or straight-horned antelope of Central Africa, of which there are profile representations in the ancient monuments of Upper Nubia and Abyssinia, which are intermediate in their form between this antelope and our fabled unicorn.

In like manner the perpetual dwelling in the air attributed to the birds of paradise was the way which the folks of the olden time had of expressing a style of flight, and the use of feathers, which they did not very well understand. It is worthy of remark too that it is not the early visiters of the distant climes where these birds are found to which the fabulous accounts of them are owing, so much as to the hasty conclusions formed by the learned at home, from the imperfect data which the narratives of those travellers afforded. Pigafetta was scolded by Aldrovand, and even by Scaliger, as a most audacious heretic in science for daring to say that the birds of paradise had feet, although he had actually seen them using these organs in perching; and as, in the earlier stages of discovery especially, we did not get the information direct from the original observer, but through the medium of some learned rédacteur, or the combined speculation of some learned body, and therefore the truth of the narrative was trimmed to the fashionable theory of the day, be that what it might. One of the greatest improvements which has resulted from the general diffusion of knowledge as preparatory for observing and recording observations, is the perfect fidelity with which all that is new in nature is now rendered to the world by travellers of almost every class in their own words, unencumbered by anybody's speculation; and the advances which have in consequence been made, more especially in zoological science, are unprecedented in the whole annals of human knowledge.

That birds of paradise are incapable of taking flight in any way but against the wind is proved by their migrations, as well as apparent from their feathers, and the general form of the anterior part of their bodies. They shift with the monsoons, to which the turn of the seasons in those seas is chiefly owing. The principal range of the birds is nearly under the equator, though more on the south of it than the north, and while it does not, so far as has been discovered, any where exceed 10° in latitude, or about 700 miles, and is generally much less, it ranges 25° in longitude, or 1750 miles, that is from about 125° to about 150° east longitude.

This space, though (with the exception of New Guinea, the geography of which is imperfectly known) it consists only of small islands, which if they are long are always narrow, as if it were the mere ridge of a chain of mountains rising above the water, is, on this account, the garden of the world in respect of the beauty, the richness, and also the peculiarity of its vegetable productions. The vicinity of the sea to all parts of the land of these small isles, and the general set of the wind from the wide Pacific, prevent these places from being visited by those severe droughts which parch more extended lands in tropical climates; but still there are shifting monsoons, and varying seasons even there; and though the birds of paradise never have been known to range beyond the limits that have been stated, that is beyond the isle of Ternate on the north-west, and New Guinea on the south-east, yet they have their seasonal motions answering to the monsoons within their own limits.

The monsoons are distinguished as the dry and the wet, the first blowing from the west, and the second from the east; but it is to be understood of all those regular seasonal winds, which are occasioned by the ordinary action of the sun upon the surface of the earth, that the monsoon, whether wet or dry, has its cause in the place toward which the wind sets. Thus, although the dry monsoon blows from the west, it begins in New Guinea, and proceeds gradually westward. It is the drying and heating of the surface of New Guinea which rarefies the air, makes it ascend, and thus puts the monsoon in motion. And when the heat and drought have become sufficient to produce these effects, the woods of that island are in that state in which they furnish the least possible supply of food for these dwellers on their tops. Consequently the birds are compelled to seek better pastures; and their very structure, whenever they get on the wing, turns their heads and preserves their courses in that direction in which food is to be found. This dry monsoon from the west does not extend very far to the westward of the limit which has been mentioned; because, further west, the larger lands which lie on opposite sides of the equator (Asia on the north, and Australia and Africa on the south), give another direction to the seasonal currents; and by the way it is where the sets of these different monsoons, meet or cross each other, that the tiffoons or gusts of variable wind are so violent and so dangerous to navigation.

The drying effect of this west wind is of course in proportion to the time of its continuance; and thus the drought and the progress of the birds both proceed westward, the one turning the east wind to a west wind, and the other following up to that wind's commencement. When the western part of the range becomes dry and the monsoon shifts, the birds again return upon the east wind, and reach the different places as the rain has brought abundance. Thus they are not in any one locality either during the rigour of the drought or the violence of the rain, but rather during that season of plenty which follows the latter.

The species of birds of paradise are differently stated by different describers, and they have been confounded with some other genera, or rather perhaps the genus *Epimachus* has been confounded with them. Indeed there is a portion of ornithology, including a number of very beautiful birds of warm countries, and ranging from the birds of Paradise to the bee-eaters, or at all events to the hoopoe, which is not very clearly defined, and will perhaps, when the structures of the different species are a little better known, require some modification in the arrangement.

There are, however, seven or eight species of birds of paradise, of which the characters are tolerably made out: and to these we shall restrict the details of this article.

They have all produced feathers with flocculent webs on the flanks, the scapulars, or both; they have in general long thread-like feathers in the tail, which end in little discs or pallettes; and the plumage of the rest of their bodies is in a great measure peculiar. All their feathers are better formed for taking hold on the wind than for making way against it; for they are all remarkable for their loose and velvet-like texture. This is remarkable in the feathers of the head, and in those of the neck, more especially in the species which have a ruff of produced feathers upon that part; but it is not confined to these, for the whole plumage of the body, and even the flying feathers of the wings, have a more loose and velvety texture than those of most other birds.

In this respect, the birds of paradise, which are dwellers on the tops of trees, or hoverers over them in the air, bear a considerable resemblance to the humming-birds, which are hoverers over flowers; and along with the same velvety texture of plumage, they have the same richness of metallic reflections, more especially in bronze colour and golden green. No contrast of plumage can be greater than that of these birds with the parrot tribe, which often inhabit among the sprays and twigs of the same trees on the tops of which the birds of paradise roost. The tints of the parrots are rich; but they are generally tints of entire colour, without gloss, and without any reflection or change of shade from the different directions in which the light falls upon them. The feathers on the parrots are also in general firm, hard, and well made out, as if suited for enduring the contact of those branches among which they have to make their way, while those of the birds of paradise appear to be fit for contact with the air only. The plumage of the one set of birds bears, in fact, some resemblance to a coat of mail, while that of the other is soft and flocculent all over. The texture of feathers, as varying with the haunts and habits of different birds, has not been investigated with that attention which it deserves; but it certainly forms a very marked and therefore a very useful character; and the contrast is no where more striking than between the parrots and the birds of paradise,—the one having to find their way among the thickly ramified branches, the other only in the free air. We shall now very shortly notice the species.

1. Great (or common) Bird of Paradise. (*Paradisea major*). The trivial name apoda, which has been given to this species is inaccurate, as the bird, instead of being "footless," as that name implies, has very stout feet, though short in the tarsi, and otherwise not well adapted for walking on the ground. They are, however, very efficient perching feet; and from the peculiar way in which the toes are united, and the great length of the hinder toe, they are well adapted for resting, not merely by perching on a twig, but on the top of the leaves, as, though differently constructed and differently used, they still bear a resemblance to those feet with the produced hind toe and claw which fit their owners for walking upon tall and elastic herbage on the ground.

This species is the one which is best known and most generally used as an ornament. The use of it in this way in the East is not confined to the head dresses of females, as it is in Europe; for the chiefs use it in the adorning of their horses. It has thus been in request from the earliest times of which we have any knowledge in those eastern climes; and the natives of New Guinea, from whose country it is obtained in the greatest numbers, as it is more abundant there, and found for a longer time of the year than in the Moluccas, endeavour to kill or otherwise procure it without any wound to the skin, or if possible any ruffling of the plumage. These islanders are very expert bowmen, and the bows which they use in their wars are of such power that they can send a pointed arrow to the depth of two or three inches into the planking of a ship. But when they shoot these birds they do it with blunted arrows, or even with arrows which have their heads padded, so that they only partially stun the birds, and neither penetrate the skin nor injure the feathers. They also sometimes use birdlime for snaring or entangling the birds; but, as they roost high that method of capture is attended with very considerable labour, so that the favourite mode is that of shooting with the blunted or padded arrows; and the wings get so easily entangled in the produced feathers of the flanks that the birds are brought to the ground very readily, and when they are there, they are helpless and easily taken. The feet and wings are then removed, the body drawn, extended on a stick inserted by the bill, and then dried in smoke to such a degree that it is not liable to be destroyed by insects.

The general appearance of this, which is the handsomest bird of the genus, may be seen by examining the first figure on the plate "Birds of Paradise." It is about one foot in length, from the point of the bill to the extremity of the tail; but the produced feathers of the flanks, which are exceedingly light and beautiful in their form, extend about a foot more. The general colour is a rich cinnamon brown, but it varies considerably on the different parts. Over the nostrils and on the forehead there are very thick, soft and velvety black feathers, with green reflections. The crown and nape are pale yellow; the throat golden green, the hind part of the neck purple brown, the rest of the upper part, and also the breast and belly, maroon brown; the bill yellowish black, and the feet black. The colours are subject to considerable variation in different specimens, as for instance, the throat is of every shade from golden green to a rich golden yellow; and when this part is more inclined to yellow, all the rest of the bird is of a paler tint; but whether these variations are the result of difference of age or season, or whether they are permanent for the life of the birds, has not been ascertained.

The produced feathers on the flanks, and in the tails of these birds are among their most remarkable external characters. Those which originate in the flanks are of a pale yellow or straw colour for the greater part of their lengths; but they are marked with purplish red toward their origin. It is difficult to imagine any structure more beautiful. The shafts are finely tapering, and the fibres of the webs, which are quite detached from each other, have secondary ramifications; and, the whole are fined off toward the extremities, so that they really more resemble the tail of a comet than they do any more solid matter; but unsubstantial as they seem toward their extremities, the shaft and web are so well proportioned to each other that the whole feather floats far and gracefully; and with the very maximum of tenuity it has no appearance of weakness. Besides those, there are two very peculiar filaments of feather, covered with velvety down, interspersed with short stiff hairs, which have however nearly the same lustre as the down, which originate one on each side of the rump, and both extend to nearly the length of two feet. These are yellowish at their bases; but for the greater part of their length they are nearly black, and show a very peculiar mixture of greenish lustre, which can hardly be called a reflection, for the hue of it is velvety rather than metallic, and it is a very intense and rich colour; though there is so small a portion of this green that it is only visible in certain positions of the light with regard to the feather, yet when the eye can catch it, it is of the most intensely rich shade that can possibly be imagined. It is said, however, that the skins, whether prepared by the usual methods of the natives or not, which are brought to this country, have the green shade less rich, and the whole colour inclining more to yellow, than in the living and healthy bird; and especially that the smoke-drying, which is found necessary in order to preserve the skins from the ravages of insects, imparts a brown and muddy tone to all the richer tints of colour.

These produced feathers, whether they originate from the flanks or the sides of the rump, are wholly unconnected with the flying feathers of the birds, which both in the wings and tail are short. The wings are hollow as well as short, or rather they have a peculiar curvature, in consequence of which alone, one would be led to infer that they have not the same kind of action as ordinary flying feathers, by means of which birds make their way in the air; and though the body of the bird is not a very heavy one, the wings are so small that they seem incapable of floating it freely without these produced feathers. We are still, however, too ignorant of its economy to be able to speak with confidence on the subject of its very peculiar mechanical action in the air.

2. Royal, or King, Bird of Paradise. (*Paradisea regia*). The species of these curious birds have been as unfortunate in their names as in their history. There is no attribute of royalty in this one, any more than there is a particular reason for applying the epithet superb or magnificent to two other species which remain yet to be noticed. The species which has been already described, to which the equally humble and faulty name of "footless" has been given, is unquestionably the finest bird of the genus, and therefore the one to whom superlative epithets are the most applicable. Those superlative epithets are generally rather awkward in science; for in all cases where *magnificus*, or *splendens*, or *gloriosa*, has been applied either to a bird or a flower, it has generally turned out that some other species, which had to be called by a humbler name in consequence of the appropriation of the superlative one, put not only the species with the lofty name, but the party by whom that name was given, completely to shame. To this, the lofty names of some of the birds of paradise do not form an exception.

The species in question which is No. 2 on the plate, is a much smaller bird than the former; and, so far as its habits are known, it is not nearly so much "a thing of the air." Its produced feathers, although peculiar, have none of the airy beauty which is so conspicuous in the larger bird; and it does not appear to be so capable of migration. It has not often been found out of New Guinea, while the other ranges with the monsoons not only to the Moluccas, but to some of the isles further to the east.

The king-bird is not one eighth of the volume of the common one, being only from five inches to five inches and a half in length. It is also less royal in its habits; for while the other is found chiefly in the air, or on the tops of lofty trees, and on its migrations sails majestically in company with its associates, this species is a bark bird, seldom found on a very elevated perch, and solitary and shy in its habits. That it does migrate is understood, because the food of such birds is seasonal in the places which they frequent, and this species feeds principally on berries; but it is seldom seen on its migrations; and as its produced feathers are not of the same floating character, its style of flight cannot be so peculiar.

The upper part of this species is reddish brown, of velvety texture and gloss, the pouch and part of the head rich orange of the same, with a small black spot at the inner angle of the eye. The chin is of a rich nut brown, forming a large spot upon the upper part of the throat, and passing into a margin of pale and yellowish brown; and that again passes into a gorget of very intense golden green, with metallic reflections. The rest of the under part is leaden grey. The feathers of the flanks, though not long and flocculent like those of the former species, are considerably produced, but they incline downwards, and save the legs more than they do the wings. For the greater part of their length these produced feathers are of nearly the same subdued tint of leaden grey as the common clothing feathers of the under part, but toward their extremities they become more brilliant. There they have, first, a narrow line of white, then one of the same rich nut-colour, as appears on the skin, and after these there is a broader band of exquisitely rich emerald green. The flying feathers, both of the wings and the tail, are dark nut colour, or reddish brown; and two of the tail feathers, or rather two feathers from the rump (for it is thence, and not in the true tail, that the produced caudal feathers of most birds have their origin), are produced beyond the rest to a distance about equal to the whole length of the bird, and they are very peculiar in their shape. For the greater part of their length they continue nearly parallel or very little divergent from each other. Toward their terminations they curve outwards, or apart from each other, and at the ends they curl into a sort of spiral discs, consisting of nearly two convolutions, but with an opening in the centre. The webs which form these discs are all upon one side of the shaft, which, for the greater part of its length, is covered with velvety filaments, as in the former species, and interspersed with small barbs of stiffer texture. The discs in which these two feathers terminate are of a very rich golden green, with metallic reflections. The naked skin on the feet of this species is of the same soft leaden grey as the under part of the body, and the bill and claws are yellow.

3. Red Bird of Paradise (*Paradisea rubra*). This, which is a very elegant, as well as a very beautiful species, is figured on the wing, as number 3, on the plate. It is much more a floating bird than *regia*, though perhaps not so much so as *major*. It is between nine and ten inches in length from the extremity of the bill to that of the tail. The upper part, the sides of the neck and the breast, are yellow. The feathers at the base of the bill, which cover the openings of the nostrils, are velvet black; and those on the top of the head, which have the same soft texture, but are much more produced, and parted in the middle so as to form a sort of double crest, are of a fine golden green, and they partially extend over the nape and sides of the neck. The lower part of the breast is brownish, and the flying feathers of the wings and tail brown. The flanks are furnished with numerous produced feathers, which are detached from each other, and bare and flocculent on their neck, in the same manner as those of the species first mentioned; but their direction is much more across the axis of the body, their curve more downwards at their points, and they are very differently coloured. They are of a deep and full red, or the character which may be considered as blood red, or the nominal or primary tint of that very varying colour; but still their tone is subdued, and more inclining to that of venous than of arterial blood. From the sides of the rump there proceed two thread-like feathers, of an intense black, a little flattened, curving on their upper sides, and concave on their under ones, which extend to the length of from twenty inches to two feet in their different specimens. Their feathers are nearly straight and tapering, and without any convoluted discs at their extremities, like those of *regia*. The bill and feet of this species are brown. Its head-quarters are in New Guinea, and it does not appear to be so discursive in its range over this island to the eastward as some of the other species.

4. Magnificent Bird of Paradise (*Paradisea magnifica*). This is the fourth and last species figured on the plate, and, like *regia*, it is a small species, though considerably larger than that, being at least half an inch longer, and proportionably greater in all its other dimensions. The upper part is of a rich and brilliant brown. The feathers over the nostrils and on the head short, but very thickly set, and of a rich reddish brown. The top of the head green, with metallic reflections. Around the neck there is a double ruff of produced feathers. The first, or nearest the head, and shortest one, is composed of straight feathers, of a reddish colour, and with black spots on their extremities. The second, and larger one, is straw yellow, with the colour darker towards the extremities of the feathers. The ends of the feathers of both are squared and abrupt, as if they were trimmed by a pair of scissors; but the webs of that part have the same velvety texture which characterises all the produced feathers upon birds of this genus. The primary quills of the wings are of a fine crimson colour; the coverts yellow on the upper sides, and brown on the under. The secondary and tertiary quills brown. The throat and breast are clouded with green and blue on the middle, passing into brownish green on the sides of the breast, and the belly is bluish green. The feet and bill are yellow on the principal part, but the tomia of the latter are margined with black. With the exception of the double ruff, which gives a very singular appearance to the neck, there are fewer produced feathers upon this bird than on most of the others, but there are two very beautiful ones arising from the sides of the rump, extending to some distance nearly parallel

to each other, and then forming two wide circular loops outwards. The colours of this bird are exceedingly rich, without being gaudy, and they harmonise remarkably well with each other. It is found principally in New Guinea, and as it wants the floating feathers on the flanks, it is like the species mentioned second in order, more of a land bird than of a tree and air one.

5. Six-threaded Bird of Paradise (*Paradisea esxsetacea*). Some notion of the general form of this species may be obtained from the annexed representation. It is a native of New Guinea, and measures ten or eleven inches in length. The prevailing colour of the upper part is rich velvet black. The front and top of the head are thickly set with slender feathers, a little produced, and mottled black and white, so that they have something of the appearance of a grey crest. Each side of this bird is furnished with three produced and thread-like feathers, about six inches long, of a black colour, and having a small oval disc at the termination of each. The feathers of the neck have reflections of golden green, and on the flanks there are produced feathers of a black colour, and with large and flocculent webs, which cover the wings when the bird is in a state of repose. The head and breast of this species are of a very rich and brilliant golden green; they are somewhat long on the breast, and it is the margins of the feathers only which are green, the central part of the feathers being black. The feet and bill are brown. In addition to the six filament-like feathers on the sides, from which the name *sexsetacea* is derived, and the produced feathers on the flanks, some

Six-threaded Bird of Paradise.

of the coverts have their shafts ending in produced filaments. Altogether, this is one of the most gorgeous birds of the genus, though its colours are five in number. The black, which is the prevailing colour, is, from its velvety texture, of the most intense depth, not returning a single particle of light, while the blue and yellow of which the green is formed show every tint, according as they are turned to the sun, from the finest gold to the very verge of blackness, and in all the varieties there is a very rich lustre. Thir species is not so common as some of the others.

6. Superb Bird of Paradise (*P. superba*). This species is smaller than the above-mentioned one, being only between eight and nine inches in length, and altogether it is not so gorgeous in appearance, although its colours are more varied and showy. The clothing feathers on the upper part are black, glossed with reflections of green and purple; the forehead has two small crests of black silky feathers; the fore part of the neck is black, with blue and purple reflections, of which the lower feathers are considerably larger than the rest, and form two points, which hang down the sides of the breast, something in the form of a forked tail. The back of the neck and breast are of a rich golden green; the belly, and also the feet and bill, are black. From the scapulars there arise long feathers of loose texture and of an intense velvet black, which curve backwards and outwards, and in part cover the wings. This species is found throughout the whole range of the migration from Ternate to New Guinea. The following figure will give some general idea of its form.

P. superba.

7. Small Green Bird of Paradise (*Paradisea minor*). This bears so near a resemblance to *P. magia*, the species first described, that it may be only a coloured variety, arising from age, or some other circumstance. It has been found only, or chiefly, in New Guinea. It is about nine or ten inches in length from the point of the bill to the end of the tail. The upper part is bright maroon; the sides of the head, the back of the neck, and upper part of the back, pale yellow; the feathers at the base of the bill soft and velvety, and black, with purple reflections; the throat and upper part of the breast bright green: the rest of the under part rich brown; some of the coverts of the wings bright yellow; the feet yellowish, and the bill yellow, with a black margin on the tomia. The flank feathers are very much produced and flocculent; they are yellow and white, and the filamentous feathers of the tail have a very considerable resemblance to those of *major*.

The following figure is a representation of this species.

P. minor.

Such are the principal species of these curious birds, and indeed the only ones which can be satisfactorily proved to belong to the genus; but there have been, as was already stated, some species, principally of the genus *Epimachus* of Cuvier, though those last are by him classed among the tenuirostres, and are, from the structure of their feet, anisodactylic birds. But the foot of the birds of paradise is also a peculiar one, and, in a strictly natural arrangement, would prevent the classing of them with the common omnivorous birds, which have all the toes free, and the feet equally fitted for perching across a twig and for walking on the ground. Their foot is not anisodactylic, with the two outer toes united together, and acting against the inner and the hind one; neither is it syndactylic, having the external front toe and the middle one of nearly equal length, and so united together as to have partly the firmness of one broad toe. But the foot of the birds of paradise partakes something of both characters, though it is the inner and the middle front toe which are united, and the union does not extend so far as in the syndactylic foot. The outer and middle toes are united and soldered at their basis, and the hind toe is very long in proportion to the rest.

This foot does not thus come within any of the descriptions of feet to which characteristic names are given, and the habits of the genus are also different from any of those with which we are familiar; and as the genus *epimachus* and the genus *paradisea* inhabit not only the same country, but the same forests, and are both perchers, and have produced feathers on the flanks, we must consider them as naturally belonging not only to the same order, but to the same group. They resemble each other even to the velvety feathers on the head; and it is a very common law among birds, that where there is a similarity in texture of feathers (how much soever the colours may differ), there is a similarity in feeding and in the general habits.

So closely do some of the species of these two genera resemble each other, that it is highly probable, that when Cuvier changed the *Paradisea alba* of former writers to *Epimachus alba*, he was misled (as continental naturalists have been on former occasions), by a mutilated specimen. He says:—"*Les pennes primaires de ses ailes sont courtes, et beaucoup membreuses qu' aux oiseaux ordinaires.*" That this must have been the case with the specimen (a skin, in all probability, upon which Cuvier founded his description), is true; for of the subject before him Cuvier was an accurate observer and a faithful describer. But it really appears that this specimen must have had the wings mutilated by the abstraction of the whole, or the greater part of the primary quills; for though the primaries are not very long, as they never are in any of the tree birds which have produced feathers, they are as long as in the ordinary birds of paradise. This species, if coincidence in all the leading characters is to be considered as the foundation of every arrangement, should make an eighth species of the bird of paradise.

8. White Bird of Paradise (*P. alba*). This species inhabits the same places, and has the same habits, as the others. Its length is about nine inches and a half. The feathers of the flank, which are produced in the same manner as the others, are white, with some markings of yellow. The filaments, which are twelve in number, or six on each side of the bird, issue not from the rump, but from the produced feathers of the flanks, and these filamentous productions are about the thickness of a horse-hair, ten inches in length, and twisted or curled in different directions. The wings are of exactly the same form as in the rest of the genus. This species is certainly much less gay in its plumage than most of the order; but if general form and habit are to be the foundations of arrangement, it is much more entitled to be considered a species of this genus than *P. micra* is to be a separate species from *major*.

We must expect some time to elapse before the natural history of these long and deservedly-celebrated birds is any thing like perfect. They are not easily observed in their native climes, because, when in a state of repose, they are on the tops of the very highest trees. Their countries, New Guinea especially, is very unsafe to visit for scientific or any other purposes; the natives are watchful of their birds, as they constitute no inconsiderable branch of their rude commerce; and the skins which can be purchased of them, whether of the true birds of paradise, or of any of their gay brethren of the spicy groves, can hardly be obtained in any other state than mutilated and prepared for the market.

They seem also to be as delicate, and difficult to be transported, reared, or kept alive out of their own very peculiar locality, as the mangosteens and durias, and other choice fruits of that oriental archipelago. There has, we believe, been instances of their arrival in this country not absolutely dead, but they were barely alive, all those fine and peculiar feathers fallen off, all the beauty of their colours gone, and they themselves were landed only to pass a few days in pain and misery. We might infer this from their habit of perching and basking under the ardour of the tropical sun, as well as from their proneness to migrate even in that part of the world, where the weather makes the nearest approach to perpetual summer.

BISMUTH. A mineral but little employed in the useful arts. It is found in the native state somewhat alloyed by arsenic or cobalt, either massive, dendritical, or in the form of a regular octohedron. The ores of bismuth are but few; in that called sulphuret of bismuth, it is combined with sulphur; in another, called bismuth ochre, it is mineralised by oxygen, and includes a small portion of oxide of iron. It also occurs mineralised by the carbonic acid. Native bismuth is rare, as well as its ores; these are found in veins, mostly in primitive mountains, accompanied by the ores of cobalt, of iron, of zinc, and sometimes of silver; and by quartz, calcareous spar, and barytes, in Bohemia, Transylvania, France, and Sweden. The sulphuret of bismuth has occurred in Cornwall, as well as the oxide.

Bismuth unites with most metallic bodies, and renders them in general more fusible. When calcined with the imperfect metals, it produces the same effect as lead in cupellation; combined with the latter body, it produces a fine coloured alloy.

BISON. The name of one of the subgenera or groups, into which, for the sake of brevity and perspicuity of description and consistency of geographical distribution, modern naturalists have divided the great genus Bos (the ox), the most useful to man of all the ruminant mammalia. For the general characters of the genus, and the number and distribution of the several groups, we refer to the article Bos; and for the structural character of the order, which is a very well marked and natural one, to the article Ruminantia; so that we may in this article confine our observations more exclusively to the group of which the name stands as title.

We may, however, remark that the domestic ox, with whose appearance and uses every one must be familiar, though broken into varieties almost innumerable by the effects of climate and domestication, possesses nearly the mean or average characters of the whole genus; and may therefore, in all cases of reference, be considered as the type, by their differences from which all the groups in their several species may be most clearly and briefly described.

There is not a better general means of distinguishing the different groups of animals of the same genus, that is which possess the same general type of organisation, in the number, form, and arrangement of those parts of which their bodies are made up, than the shape of the bones of the head and face. Even in the human race, who we are taught to believe are, in all their tribes and varieties, descended from a single pair, we find that the general shape of these bones is one of the best means of distinguishing tribe from tribe; and though attempts have been made to carry this means of judging too far, and to draw conclusions from it which not only it does not warrant and will not bear, but which cannot in the very nature of things be drawn from any structural form or arrangement whatever; yet within proper limits this mode of judging is among the best analogical ones which we have.

Even in the case of man, though as applied to man himself the terms of the analogy have often been reversed, and the mere frame, which is the passive part of man's compound nature, has been considered the active one, much in the same way as we would allege that the tool employs or uses the hand in working, instead of the hand using the tool;—even in his case, though the form of the head, in the opinion of the writer of this article, cannot possibly throw any more light upon the physiology of the mind, than can be thrown by the form of the limb, or any other part of the structure, yet a knowledge of the effects which are produced upon the form of the human body by external circumstances is of much use to us in studying the general history of animated nature, and especially that very interesting and useful part of it, the adaptation of animals to the several climates over which they are locally distributed. This subject bears so closely upon the group of animals which we are about to examine, that a few words on it will facilitate instead of retarding our knowledge of that group, at least if this knowledge is to extend any farther than mere names and external appearances, which can hardly be said to deserve the name.

This is the first instance which has occurred in the alphabetical arrangement of this work of any portion of a genus of mammalia, generally distributed in its different sections over the cold, the intermediate, and the warm latitudes, and which neither hybernates nor is capable of migrating, except for short distances within the same country; it is therefore the first opportunity which we have had of alluding to the adaptation of different sections of the same genus to very marked differences of climate; and consequently it is the one in which we can most valuably and profitably introduce some allusion to the general principle of such adaptations; and we shall find the case of man of no little use for illustration; and the more so that man is not, in strict propriety, part of the system.

The general principle stated briefly is this: it agrees with the unity and perfection which, wherever observation has been extended, belongs to the whole system of nature, and follows almost as an immediate consequence of these being there, that the plants and the animals which are found native in any climate or locality, whatever it may be, are the best adapted to it in all its average circumstances; and the worse adapted for any other climate or locality, in proportion as the circumstances of that locality differ more from those of the native region of the plant or animal.

But if this mutual adaptation of place and native inhabitant be general, as it certainly is, we are unable to say that either of the two is adapted for the other, because the position admits just as readily of being inverted; the hill-top, for instance, is adapted to the ptarmigan, and the ptarmigan to the hill-top; and in all cases, as well as in this one, the natural adaptation is mutual and reciprocal. They are not *different* things adapted the one to the other, by the act of a third agent, in whose hands they are both passive; they are self-adapting, and accommodated to each other by that law which their Maker has implanted in them, and in virtue of which they are what they are found to be, and not something different. When the plant or the animal is of such a nature as that it can give way, and in so far accommodate itself to a place originally not quite natural to it, it always approaches to the natural type of that place, if there be any native creature there which has the same general organisation.

Further, it is found that races which are natives of regions where the natural circumstances are the most variable can most readily accommodate themselves to new places; a native of the mean latitudes can accommodate itself much better either to the tropical or the polar ones than a native of any of these can accommodate itself to the middle latitudes. The horse, which is supposed to be a native of Central Asia, can live and preserve his spirit in Lapland or Java; but no art could keep the white bear of Lapland permanently on our shores, or the ape of Java in our woods. Thus, though circumstances can produce a considerable degree of modification, there is a natural limit which they cannot pass, a natural adaptation of creature to situation which they cannot bring about, even with all the assistance of art, in attempting to accommodate the place to the creature.

In all these cases of limit, and the limit is never a very wide one, unless the time allowed for the change is great, the animal cannot make what we call a *voluntary* effort to pass the limit; it cannot anticipate by reasoning what is to take place, and meet it by expedient, as man does. Thus when the circumstances of the locality in which it was at first native and at home, as it were, change either more extensively or more rapidly than the power of its nature to yield to circumstances can bear, the animal can subsist no longer, and so becomes extinct; and the only memorial of it that is left is its bones, in the debris and rubbish, or the impressions of them in the more consolidated strata.

It is to the mammalia chiefly, among vertebrated animals, that these observations apply; and therefore it is chiefly their bones which are found in the apparently more recent deposits. We do not find the bones of birds, because they can gradually retire as the changes occur, or take to the wing and escape from more hasty contingencies.

The judgment of the future which man is enabled to make from the experience of the past serves him even in better stead than the wings and power of aerial motion do the bird; and therefore, though there are accumulations of human bones, the result sometimes of sudden natural catastrophes, but much more frequently of the wars of mankind with each other, we never find the remains of an extinct nation preserved in the soil, as we do those of various species of mammalia, some of which have perished from those regions in which their bones are found, and others altogether from the face of the earth as living creatures.

But the power which the use of experience and reason gives man, both of enduring differences of climate, which no other animal can endure, and of maintaining his possession during changes which no other animal can undergo, is of itself perfectly capable of enabling the circumstances of climate and time to have produced in him, out of one, all the varieties which we now find—out of one original race—one original pair. With this resource, man might see race after race perishing around him, and the character of the country and the successive generations of men so changing with the lapse of long periods of time, that were it possible for the men of remote antiquity to visit the places of their former habitation, they would not know their former abode, and would reject their lineal descendants as a new and a strange people. This almost unlimited power in man to accommodate himself to the differences of climate and situation, if they come on him with sufficient slowness for enabling him to make use of the resources of his reason, release him from that bondage to climate which attaches to all the mammalia which have not the power of migration with the seasons. There is thus no natural necessity for a separate typical man of each different climate, as there is for a typical species of the mammalia where the genus is generally distributed, and the individuals incapable of migration; for if man moves slowly enough towards any climate, and takes the due precaution, he can be just as much the man peculiarly adapted for any one climate as for any other.

Those mammalia which man has long held in a state of domestication hold, in respect of this adaptation to climate, a sort of intermediate place between man and the species, even of the same genus, which are left to the contingencies of circumstances in free nature. The domesticated animal partakes in the protecting contrivances of his master, and therefore is enabled to live and become more and more adapted to the climate in each succeeding generation. So much is this the case that in climates which are much inferior to those out of which the animals are originally brought, no small part of the cultivator's art consists in preventing too much accommodation to the climate.

These circumstances bring us very naturally both to the original characters and the progressive history of the bisons. They are naturally the arctic tribe of the genus bos; and unless it be about the longitude of the Himalaya Mountains, where not only the chain of being but almost the very same race appears to extend from Siberia to India, the bisons appear to have been in all ages inhabitants of the northern latitudes only. There is no vestige of them in South America, where ruminantia appear never to have existed as inhabitants of the plains; there is no vestige of them in Australia, and so far as is known there are no ruminantia there; there is no vestige of them in Africa, though ruminant animals of other genera, and of the more tropical groups of the same genus, are by no means rare; and the species of Southern Asia, which have been referred to the group, are of somewhat doubtful admission into it, or if they are of the same stock they are wonderfully altered by climate, for animals which have never been in a state of domestication, and thus have derived no assistance from the protecting care of man.

As natives of less fertile and more inhospitable places than the rest of the genus, the bisons are endowed with greater courage, proportional strength, and relative power of locomotion. They have a daring and even a ferocious aspect; and they are as savage as they look. The beasts of prey can take or master them only by stratagem; and the wild hunters of the places in which they are still to be met with, who are equally bold and skilful in the hunting of animals, as they depend chiefly on them for their food, consider the bisons as their most dangerous game.

In consequence of this boldness and ferocity of character, the bison has never been domesticated, but left to the contingencies of wild nature, and those changes which its haunts have in the lapse of ages undergone, without any advantage from the arts of man; but rather the reverse, as both his personal safety and that desire of fame by conquering powerful animals which is so characteristic of man in a state of semibarbarism, by what name soever that state may be called, have induced him to thin, by every act in his power, the numbers of those animals.

And here, contrary to what we would expect on a first and superficial view of the subject, the course of natural circumstances co-operates with this disposition in man. The most powerful and formidable animal, the one which we would have imagined to be so sinewed and so spirited that it could overcome all contingencies and hold its ground against time itself, is the very first to give way. The northern elephant was, in all probability, the most powerful animal that tenanted the arctic lands; and of it there are no memorials save its bones in the accumulations of rubbish, or a few specimens preserved in the ice, just to let the curious know what a giant creature it had been. The same is the case with the giant bear and the giant stag; and while there are bones of bisons of nearly the same dimensions as those of which a living remnant is yet left, in places where no live one has been found within the limits of historic record, there are embedded at still greater depths bones of bisons of much larger and even gigantic size. These, from the situations in which they are found, do not, as is the case with the more ancient races, which show greater structural differences from those which exist at the present time, give any evidence of having perished by any disturbance of the strata—anything that can be considered as geologic revolution, but in consequence of the ordinary surface changes, which take place in the common course of time by the common action of the weather. Thus they tend further to prove (if further proof were necessary) that those animals which are in their own nature the most powerful and stubborn, are the first to yield to those general agencies which, in a placid though constant and successful manner, alter the state of things on the surface of the globe.

Those gigantic bones must have been more common nearer the surface, and therefore more familiar to common observation, in times long gone by, than they are now; and it is not improbable that in them we have types of those fabled men of giant dimensions, of which there are traditions in most countries. In those times the structures of organised bodies were but very imperfectly known, and it is no very great stretch of fancy to suppose that these giants, to whom was given the credit of erecting some of those ponderous structures which have no real history, and which have something the appearance of works of human art, whether they are so in reality or not, were fabricated out of the bones of these lost animals. Our proper business is, however, with the living species rather than with the fossil remains, and therefore we proceed to notice those bisons which are still to be met with, though the rapidity with which their numbers are obviously diminishing, renders the allusion to them as a race in progress towards extinction, a very rational part of their prospective history.

The characters of the bisons, which appear chiefly in the head are: the forehead arched or convex, instead of being nearly flat, as in the domestic ox; the breadth, measured between the orbits of the eyes, greater than the height; the bases of the horns before the ridge of the occiput; the whole outlines of the cranial bones more curved or convex; and the occiput being rounded instead of quadrangular, and passing into the line of the forehead by an obtuse and rounded angle, instead of an acute one. This form gives much greater strength to the skull, and more firmness to the bases of the horns; so that the bison can dash the head with much more impetus than the ox can, either against an enemy or against an obstacle, without the danger of equal injury either from fracture of the skull or concussion of its contents.

The legs of bisons are also longer, more clean in the make, and altogether better fitted for fleet motion than those of the common oxen, or any other division of the genus. The body is also more compact, and the strength more concentrated upon the fore part, so that in its attacks the animal advances with a powerful spring, and delivers the whole impetus of its body upon the horn, much in the same way that a lion does upon the paws; and if the rush of the bison takes effect, it is more immediately fatal than the spring even of the lion.

The produced hair on the neck and head gives it also more of a lion-like appearance, than one who had been accustomed only to the sober bearing and placid manners of common oxen in a meadow would be prepared to meet with in any animal of the same genus. This mane or shaggy hair on the sides of the neck, on the part of the head, and forming a sort of beard on the chin, appears chiefly on the males, as is the case with the lion; but there are upon both sexes two sets of hairy covering, which indicate their capability of resisting the rains and snows which occur in the northern parts. The one of those sets of covering is woolly and soft, partaking in some measure of the nature of fur, and calculated for protecting the animal against the cold; the other has the hairs individually thicker, straighter, and of more inflexible consistency, so that they are better adapted for throwing off the rain and snow.

One other remarkable difference of appearance between these animals and ordinary oxen, and indeed the greater part of the tribe, is, that the abdomen is much smaller and more firm and compact, and the whole of the hinder parts cleaner and lighter in their formation. The compactness of the abdomen is, in part, owing to an additional rib on each side: this group having in all fourteen pairs of ribs, while the other species of the genus have only thirteen pairs. Even the tongue of the bison is different; it is blue, while the tongue of the common ox is flesh coloured. The tail is not very long, but the brush of hair upon it is very full. Though the hair on the anterior part of the male is more forward, and resembles the mane of a lion much more than that of any other of the genus, the hair on the hinder part is comparatively short, especially in summer after the old coat is cast, but it gets more shaggy, and also fades in colour during the winter. One other remarkable characteristic of the animal is the thickness of the hide, which is more than double that of any other ruminant animal of the same dimensions. These animals are very indiscriminate in their attacks, and evince as much hostility to the other species of their own genus, which are incapable of doing any harm, as they do to the carnivorous or mammalia.

There still exist two northern species of those very powerful, and on account of their daring energy, very interesting animals, one in the northern part of the eastern continent, and the other in America.

The common Bison (*Bos Bison*). Is a forest animal, better able, from the texture of its covering, especially that of the anterior part of the body, to endure cold than heat. In ancient times it appears to have been very plentiful in what was then considered as northern, but which is now central Europe. At that period the whole line of country from the Rhine, indeed from the shores of the British seas, along the north side of the Alps, and all the way to the confluence of the Don with the Black Sea, and probably in continuation to the centre of Asia, appear to have been one vast forest, consisting of an admixture of the pine family with deciduous trees, according to the different qualities of the soil. It appears to have been a forest bearing no inconsiderable resemblance to those which covered great part of North America, when that country was first made known to the Europeans; and of which the remains are still met with in the unsettled places. This forest, as is the case with that of America, was a great source of cold, in consequence of the evaporation caused by the surfaces of so many leaves, and the shade of the trees not allowing the rays of the sun to act upon the ground. This forest was the abode of many wild animals, and of the bison among the rest.

Common Bison.

The bison was thus, though abundant, only occasionally seen by those of the ancients who have left their observations or their annals on record; and therefore we need not be surprised that the accounts which they have left of it are both vague and contradictory, or that both they and the writers of the middle ages, and also some of the readers, following their example, should have confounded it with the *urus* another species of the genus, which is supposed to be the original stock of the domestic ox. Both animals appear to have inhabited nearly the same localities, or if, as is probable, the bison was the more northerly dweller of the two, both met on the confines of their wild pastures, the bison more in the depth of the forest, and the urus more in the glades and openings. As a forest animal, the bison of course subsisted in great part upon leaves, but on the leaves of deciduous trees only; for the quantity of turpentine in the leaves of pines causes them to be rejected by all the genus. Hence, in those countries to the south-east of the Baltic, which are still covered with pine forests, continuously or in patches, there are no bisons; the few which yet remain in Europe, being found near the north-east of the Carpathian Mountains, or in the more thinly inhabited parts of Russia, which are rich enough, and far enough to the south to be covered with deciduous trees. In western Asia, between the northern plains and the central straits, they are said to be more numerous; but they are not found on the steppes of Siberia, or in the pine forests toward the north of that country. The same appears to be the case with the American species, though there are differences of habit, and even differences of structure between that and the bison of the old continent. The bison then is not found in the pine forests of the north, nor in the dreary country which extends from the great lakes to the polar sea. There, as in the northern extremity of the eastern continent, the only ruminant animals are deer, which being fleeter-footed, are better able to range these wild places than even bisons; and capable of supporting themselves upon lichens, which may be considered as the verge of the food of herbivorous mammalia.

As the bison was seen only occasionally, and as it is a shy and wary animal when it can escape, as well as a bold and daring one when it cannot, it has received many names; and the accounts of it have always been, and in part continue, mixtures of fact and fable, mixed up so intimately that it is not easy to separate the one from the other.

This animal is called *Tseber* by the natives of that part of Poland (now territorially of Russia) where it is found, and it is styled *Aurach* and *Wizend* by the Germans. The radical part of the word *Aurach*, though differing a little in the terminal part—there being a tendency in the vernacular use of imported words to naturalise them, as it were, by affixing a native termination, appears to be very common in all the northern tongues—seems to mean a shaggy creature, may even mean a creature of the imagination, and has been indiscriminately applied at different times to the bear, the lion, the bison, and the wild bull; so that etymology, generally a very unsafe guide, is not to be depended on in endeavouring to trace the progressive history of the bison.

As now found, it is certainly the largest, not only of the native ruminantia of Europe, but of all the land mammalia. The height of full grown specimens at the shoulder is at least six feet; but it is lower at the crupper; the height at the shoulder is in part made up of the very much produced processes of the interscapular part of the spine. These are so much elevated that when the animal is lean they are prominent, and their ends have a sort of pectinated appearance; but when it is in better condition the parts get full and rounded, and these bones are concealed. This production of the shoulder cannot be considered as a hump; but there is no doubt that it in part answers the same purpose; namely, that of a magazine against the season of severity, a season which from the nature of their haunts and their food, must have been severe upon the bisons, as the time which the deciduous forests were leafless must, in consequence of the greater cold, have been longer there than it is now.

These accumulations of matter for the supply of the animal, at those times when there is little of the ordinary external food to be obtained by the mouth, are a very beautiful provision of nature, for preserving the herbivorous mammalia of seasonal climates, during that portion of the year when, but for this provision, many of them must perish. In southern latitudes this provision, which appears on some of the ox tribe as well as the camels, in the form of a hump, is as a provision against the season of drought. Among the oxen of the middle latitudes, where the grass or other herbage is more perennial than at either extremity of the quadrant, and which feed more on the open meadows, and therefore can range to greater distances as the seasons render it necessary, the accumulation is less; and the portion of it which is localised is principally in the dewlap under the sternum.

But for the bison which is a forest animal, and has its natural pasture bare, or nearly so, during the winter, (although at that season these animals gnaw the twigs and buds,) a winter store is necessary, and yet in the march of the animal among the branches and underwood, a loose hump or large dewlap would be inconvenient and liable to injury. The accumulation in it is, accordingly, embedded on the produced processes of this part of the spine, by which means it has a firm hold, and neither loads the animal as a weight, nor is so liable to injury as if it were an attached accumulation.

This provision not only adds to the height of the shoulder, but gives the animal a greater appearance of strength in that part than it possesses in reality. Still the bison is both a tall and a powerful animal. Its length in full-grown specimens is upwards of ten feet; but as its spine is much more elastic than that of the common ox, and it stands with the spine a little curved and the feet nearer each other, it does not appear to be so large as it really is.

The head is broad; the forehead rounded; the horns far apart from each other, short, stout and slightly bent upwards. Their form, and the manner of their attachment to the head, give them much greater firmness and power than the horns of the ordinary ox. These in the wild animal in a state of nature, and without any regard to the endless varieties of form that have been produced by domestication, are nearer to each other at their bases, spread wider at the tips, and inserted behind the arch of the top of the head. On this account, the horns of a common ox never can act with their greatest strength, and be at the same time urged on by the force and momentum of the arch of the body. It is rather in the forehead than in the horn that the weapon of the common ox lies for this sort of combat; and the horn, which can be used with its greatest effect only when the head is oblique and the neck twisted, a position in which, if the whole body were to be impinged and meet an obstacle, dislocation or other serious injury to the neck would be the result. On the other hand, from the set of the horn, if the common ox were to spring and deliver the weight of the body upon that with the neck in a safe position the horn would be subject to a cross strain, and as likely to be broken as the neck would be to be injured in the former case.

It is different with the bison. When its neck is brought into that position which has its greatest strength, namely, when the line in which the centre of gravity of the body is situated, nearly coincides with the axis of it, the horn is placed on the anterior and lateral part of the convex skull as on the crown of an arch; and in this case, the axis of the whole body passes between the two horns, and parallel to the direction of them, so that the animal can deliver its whole momentum from a rush or a bound either upon both horns, or upon one of them, with full effect, and without injury to itself. This structure renders the bison a very formidable animal, and one which no beast of prey inhabiting the same regions would venture singly to attack, unless with the advantage of an ambuscade; while the length and fleetness of its limbs enable it to range much more freely in interrupted pastures than the shorter legged and heavier members of the genus.

The forehead, from the horns is, in this species, covered with short hair only, all of nearly equal length and texture; but the rest of the anterior half of the body is furnished with two coats, the one consisting of long, hard, highly polished, and rather stiff hairs, such as are found upon other animals which from the nature of their places of resort, have to shake off the rain or snow, especially the latter, from their covering. The under, or warm clothing, is more of a woolly texture; and it is greyish or whitish, while the points of the longer hair is blackish-brown, but fades into a rusty tinge in the course of the winter. The produced hair is very abundant on the chin, throat, and breast, forming a sort of beard upon the first. In the male, it is about a foot in length; and as it is very thick and matted, and partially connects the base of the horns and shades the eye, which is otherwise very dark as well as full and clear, it adds considerably to the formidable appearance of the animal. The hinder part of the body, as well as the fore legs from the knees downward, are covered with smooth hair, all of one consistency, like that on the face. The tail is rather short, containing a few ragged hairs throughout its length, and having a little brush at the end. This, as well as the short hair on the posterior half of the body and the legs, is of a blackish-brown colour.

This single coat where it is found has the texture of the produced hair on the forepart of the body, and not that of the woolly hair, so that the wool is to be considered as the peculiar additional clothing which adapts the animal to the cold climates. This agrees with the analogy of other animals, whether mammalia or birds. In the latter the clothing for arctic climates is not so much an additional production of down. Pigs, in cold climates, have the bristles produced something in this manner; and they have an under and woolly coat among the roots of these; and even the dogs which ventured on the arctic shore of America along with our adventurers, got in the course of the winter, not only a much longer upper coat than is natural to the species in Britain, but also wool among the roots in supplement.

The case of the dogs undergoing this change in so short a time must not, however, be considered as wholly the result of natural causes, for the animals were not so well tempered to the weather as their coats were. Notwithstanding their increased hair and their fur, they lay so closely and habitually by the fire, that their coats were burned into holes, extending more than half way to the skin, without their being at all sensible of it.

This fact proves two things; first, that those coats of animals which are thus formed are very perfect non-conductors of heat, because the natural heat of the animal must have as little tendency to pass off to the cold air as the heat of the fire had to pass inward through the coat to the body; secondly, this addition to his coat was not a natural production of the dog; that is, not one which he would have acquired in the same short time, if he had been carried to the same region and turned adrift to his own resources. He had the protection of the ship, and the warmth of the fire, and he was fed. Thus it was in consequence of human protection that he was kept alive to have this produced coat; without that protection he would have perished before the coat was obtained; and as it was not what we may call a *natural* protection, he did not, as is done by the arctic foxes and the arctic wolves, go forth armed in it, and hunt for and find his food in defiance of the cold; he cowered spiritless, and almost in a state of torpor, close by the fire, and lay there till the coat, which should, had it been the production of his own unassisted nature, have completely protected him without fire at all, was burnt half through by the heat.

It is not upon the hair immediately and directly that the cold acts; it is upon the more sentient parts of the animal, not merely upon the glands, which immediately secrete, or otherwise produce the hair or wool, but upon the general system of the animal. The hair or wool is an ulterior production, and we know not how many parts of the animal may have to be changed before the production of it is begun. There must be an apparatus formed, or, at all events, developed, capable of elaborating the new substance out of the general disposable mass of the animal, and this, which is a new action, cannot be supposed to take place in a diminished state of the general action of the system. Upon the same principle we must suppose, that such an adaptation as the double coat upon the anterior part of the bison is not a mere climatal one, produced in the course of time, but original, and, as such, specifically characteristic of the animal. It is true, that the stiff hair on the fore part of the female is not so long as that on the male, but still the female has the two distinct kinds on that part of her body; and there are physiological reasons, as well as practical instances, which lead us to conclude, that every additional production of the skin, whether of feathers or otherwise, which appears as a natural character of any species of animal, though it usually appears on the male only, and that merely at certain seasons, as, for instance, at puberty in the mammalia, and at pairing time in birds, is, notwithstanding, actually existent, either in the rudiment of the production, or of that by which it is produced, in all perfect animals of the race, whether male or female, and from the very moment of their organisation. Nor is it difficult to see why, physiologically, those apparent additions, which are thus in reality only developments, should appear more frequently and conspicuously in the male than in the female. The female system has a heavier duty to perform, in the gestation and suckling of the young; and to these grand purposes, upon which depends the stability of the race, the whole energy and working of the female system must be previously directed. But still there is not merely a similarity, but an absolute sameness of species in the two, and be it bison, or any other species, both male and female must coincide in being perfect to the *one* species, as each is perfect to its own sex.

Thus male or female, and whether this double coat be more or less developed, we are to consider it as a primary and inseparable character of this group of animals, and as it is a character which none of the arctic mammalia, which range and are exposed to the rivers, are without; for the extinct northern elephant, as was proved by the Siberian specimen, which was thawed out of a mass of drift ice toward the close of the eighteenth century, had it on still more conspicuously than the bison. According to the accounts, the accuracy of which there is no reason to doubt, the bristles of this elephant's mane were of sufficient power to break the fall of an avalanche of snow, at least such an avalanche as could be shaken from the leaves of the giant trees, which, from the remains, appear to have then existed, while this giant animal was tugging at them at its food; and, if we are to judge from the deposits, those giant elephants were contemporaries, or at least the immediate predecessors, of the gigantic bisons and stags which are now found only in similar graves, though, as none of these latter have been cast on the shores embalmed in ice, it is probable that they have belonged to a less aquatic period of that portion of the globe.

Thus, though the bison is not only a mere remnant in the existing zoology of Europe, and one which appears to be fast dying out, as not being in accordance with the present state of the country, or its surface, its climates, and its other productions, yet it is an animal of much and somewhat melancholy interest. It is, as it were, a voice from times which have gone by, the shadow of a system of things which is now no more in those parts of the world, and which, from the progress which has been made since notice began to be taken of it, appears to have no sign, in the present state of things, from which its return can be predicted, or even hoped for. Where it is now found, is not in the extreme of the bleak cold, where vegetation is stunted, but rather where, while the earth is rich and the summer warm, the winter sets in quickly with heavy falls of snow. Therefore, it does not follow, that when the bison was a general inhabitant of central Europe, the whole year, or even the average temperature of the year, was colder than it is now, but merely that the summer and the winter were much more strongly contrasted, and that the transition from the one to the other was much more sudden. Nor is it at all improbable, that, for the natural and indigenous productions of the country, whether animal or vegetable, that may have been a much more favourable state of the seasons than we have at present. This is rendered probable by many evidences which we find in this country: the bogs are full of the boles and branches of oaks and pines in very many places of the country, where even the heath itself is languishing and giving place to mosses and lichens; and we find the bones of large animals in the soil, in situations where, for miles round, not even a field-mouse can find food and cover for its nest on the surface. But though the bison is one of the few remaining animals which would enable us to embark on this tempting ocean of the past, the chart is imperfect, and we have neither star nor compass should we quit the shore.

American Bison (*Bos Americanus*). This species, though in some places it now appears to be wearing out faster than the arrow of the red man and the plough of the white are piercing its flanks and invading its territory, is still far more numerous than the former species is in any part of the eastern continent, and in many places as numerous as we can well imagine a ruminating animal of large size to be. In general the two species have a great resemblance to each other in shape, in colour, and in size, but there are some structural differences, and also some differences of habit. The specific difference, which is most to be depended upon, is the same as that which distinguishes the eastern bison as a species, from any possible variety of the stock of the common ox.

We have stated above, that even those external appendages, which appear chiefly on one of the sexes, and then only occasionally, and as it were for ornament, are all parts originally appertaining to and characteristic of the species, and, as such, may be developed in either sex, if the circumstances which prevent these developments be removed. We are, farther, to consider those developments as the perfect model of the species, beyond which nothing can vary, and that all deviations from it are stoppings short, and their causes hindrances.

Now, if such be the case with appendages which grow from the skin, much more must it be the case with the essential parts of the body, and especially with the spine and its immediate productions, for the spine may be considered as the foundation upon which all mammalia are in a pre-eminent manner organised. Now, as the spine of the common bison has fourteen ribs on each side, while that of all the varieties of the ox has only thirteen, the American bison has fifteen pairs. Farther, as the interscapular vertebræ of the bison have their spinous processes much more produced than those of the ox, so their processes are, in the American bison, much more produced than in the other. There are no such differences in the skeleton of any two more varieties of animals of the same species, and therefore we must conclude that the difference of these bisons is specific: that though they have a considerable likeness, each is an original race, and not a branch of the other.

Size is, in the genus bos especially, not a specific character, as may be seen by placing the Shetland and a Lincolnshire ox in juxtaposition. But the American bison is usually described as being, in all its dimensions, a foot less than that of the east, namely, about five feet high at the shoulder, four at the crupper, and between eight and nine feet in length. As the spinous processes over the shoulders are larger in proportion, the hump, or accumulation there, is larger, and extends farther down the back.

The forehead is very broad in proportion to its height, as in the other species, and the face is rather shorter in proportion. As is the case in the other, the face is covered with short hair only, but the short hair upon all parts of the American one has, in the cold season, a tendency to meet or curl slightly. The mane and produced hair upon the fore part generally is longer and thicker than in the other species, but it does not contain the same quantity of woolly under covering. The old coat on the short-haired part of the body comes off when the new is just beginning to make its appearance, so that, for a portion of the summer, the skin of that part, which is black, rough, and furrowed, and very strong, is easily seen. This difference of covering would of itself indicate some difference of habit in the two species.

The horns are set wide apart from each other, as in the former species, but they are shorter, not quite so robust, and bent more, first laterally, and then forwards. The eye is of the same dark colour, but smaller. The tail is larger, and the brush of hair in which it ends longer. The colour is of the same general character. but darker; and when in the perfection of its growth, the long hair on the anterior part of the body is nearly black. When this part of the skin is prepared with the hair on, it is proof against the weather.

This species is popularly known in the United States as the *buffalo*, but it has none of the characters of the buffaloes of the eastern world, farther than belonging to the same genus. So far as we can judge from the common bison, as known by the small existing remnant, the American species is much more gregarious, and as such, it is much less a woodland animal, being found in the open savannahs rather than the forests, and living more by browsing grass than by eating the leaves of trees. In accordance with their habits, it is much more migratory, and it does not appear to be either so spirited or so formidable as report makes the other species.

All these characters indicate an animal which is not so tied to its locality, but which can migrate more from place to place according to the season and supply of food; for forest animals are always more resident and less social than those which keep the open plains. This is the case with very many of the antelopes (see ANTELOPE); and it is so with all the ruminantia, in so far as they can be distinguished as animals of the wood and the open field. The causes, so far as they are known, will be found hinted at in the article ANTELOPE, so that there is no necessity for repeating them here. This species of bison or buffalo, or bonassus, as it has been called by showmen of animals when they wished to make it new and wonderful, extends over a very considerable range of the American continent. It is not met with in the extreme north, nor much higher than from the 55° to the 60° of latitude, neither has it been found farther to the south than about the parallel of 30°. That, however, is a range equal in distance to that of Europe from the Baltic to Gibraltar; and the range in climate, taking the winter at the one extremity and the summer at the other, is greater than from Lapland to Spain; for though the severity of winter extends farther south in the valley of the Mississippi than it does in Europe generally, the vegetation, and even the animals of the lower part of that valley, have a more tropical character than those of the south of Spain.

In the breadth of this latitudinal range, there are at present but few of these animals to the east of the Apalachian chain of mountains, which divide the valley of the Mississippi from the Atlantic states; and little is known of the numbers of these or of any other animals on the western side of the Stony Mountains which divide the valley from the countries sloping towards the Pacific. The western side of the great valley, the extensive meadows or savannahs which are formed along the banks of the river itself, and of all the branches which come in from the west, are their chief haunts. These savannahs are in many places liable to be inundated by the rivers, which in these cases leave large stagnant expanses of back water, as the streams have thrown up banks higher than the neighbouring surface. These floodings occasion a very rich herbage, which continues far into the dry season, and then the bisons collect in vast herds, herds which are quite unprecedented in the genus. Their tracks from pasture to pasture, and from the pasture to the pool, are as well beaten as the pathways in a thickly inhabited country. The grass on their pastures is rather rank and coarse, for there are no specimens of the velvety turf of islands which have mild winters, and frequent showers in the summer, in such countries as the centre of America. These tall, coarse, and semiaquatic grasses, which are characteristic of plains flooded by great rivers, which would prevent the more kindly grasses from "tillering," even if the germs of them were there, are in their texture and probably also in their nutritive qualities intermediate between the leaves of trees and the finer grasses; if indeed they can be considered as nutritive as the former are in the young and juicy state. Animals which feed upon such grasses generally do so in the morning and evening, when the dews are upon them; and in such places the formation of dew is often in proportion to the heat of the weather. The bisons follow this course, and during the heat of the day they retreat in great numbers to the pools of water, and stand and enjoy themselves there.

About the middle latitude of their range, that is about where the Missouri comes in from the west, they appear to be most numerous; and it is there that they have been described as assembling in such vast herds, sometimes to the estimated number of not less than 20,000 at one time. It is also there that they are said to attain the largest size, and to be of the most bold and determined character.

In these their most appropriate pastures, and accompanied as they are by rivers like seas, and single plains like counties or even kingdoms, a herd of them must be a splendid sight, especially when thrown into a state of agitation by a thunder-storm or any other cause of alarm. They are by no means so fleet footed as the more slender-bodied ruminantia; but the enlargement of their bodies forwards, the compactness behind, the flowing of the shaggy mane, and the sound which they utter, which is something between bellowing and groaning, their dark colour, and above all their numbers, must have a splendid effect.

American Bison.

In their most southerly latitudes they are migrant, and probably they are so also in their most northerly ones; but there is no reason to suppose that any of them migrate through the extremes of their distribution, which are about 2000 miles asunder, or even over the tenth part of that long distance. The very instinct or tendency, whatever it may be, which renders animals social or gregarious keeps them as a matter of fact and of course to their own herd; and they never quit that but when the others expel them by force, and the reception with which the exiled beasts are greeted by new herds, which they attempt to join, are not of the most courteous nature. Thus it is probable that where the savannah is so large as to admit of the assembly of thousands, they shift only from the one part to the other, as the seasons may require, approaching the waters in the droughts, and retiring from them during the rains.

In their more southerly localities, where the character of the seasons is more tropical, and the plains are entirely destitute of herbage, saving only aloes and other esculent plants, they are much more migratory; and have some analogy in their motion to the herds in the plains of Asia. Though even in those places the migration appears to be as much to the hill as to the northward in the summer; though they collect in the more temperate forests in winter. In the north they are of much smaller size, and shaggy in their coats, and not so spirited as in those latitudes which are the most congenial to their habits.

They are said not to be naturally vicious, but they are easily excited, and then their activity often makes them mischievous. They are capable of a sort of domestication, but they are neither very pleasant nor very profitable on a farm. Their form disqualifies them for animals of draught; and they take their range of the whole, heedless of ordinary fences. The males are rather formidable at all times; and during the rutting season, which is about the month of June, they are dangerous. Against biting animals they make a much better defence than most of the others. They keep their heads resolutely to the enemy, and as the face only is vulnerable to any ordinary bite in that direction, and the hairs are a good protection to the upper part, they stand resolutely; and they are equally dexterous at tossing their foes and trampling them under foot.

In all parts where they are found the Indians hunt them very assiduously, especially in the fall of the year when they are in the best condition. The flesh has a smoky flavour, but is very wholesome; and the skin forms the most desirable mats which the Indians possess. Various accounts of the modes of capture, some more ingenious and some less, have been published; but these belong to the history of the hunters and the hunted.

In a natural history point of view these animals are important as being the only species of the ox genus, the existence of which on the American continent, at any period of its history has been fully authenticated. There have no doubt been reports of individuals of much larger size, and supposed to belong to another species, being seen on the Stony Mountains. But the species which are known differ very much in size; and there is besides some difficulty of judging of the magnitudes of two animals when the one is seen on a mountain, or on an elevation of any kind, and the other on a plain. Deer when seen on a hill-top, projected against the sky, seem giants, and their horns to be the leafless boughs of large trees, but if one follow the very same herd till they are in the hollow and look down upon them, they seem the miniatures of their former appearance. Even the horns of the extinct species seem a little doubtful, for it does not very clearly appear, from any collateral evidence of a peculiar state of vegetation, that North America has undergone any climatal change, which would have rendered the extinction of any species of ruminant animals necessary; at least there is no evidence of any necessity of the kind, unless we are to suppose that some violent catastrophe of nature has intervened; and the possibility of anything which has disturbed the solid strata is precluded by the situations in which the horns are found, which are always such that no catastrophe greater than a mere surface one, such as an inundation arising from the bursting of a lake, or an alteration of the course of a river, can be admitted, indeed can possibly have taken place since those horns formed part of the bodies of living animals.

Besides, when America was first discovered by Europeans, it was completely stocked with the existing species, down to the very shores of the Atlantic, so that it is difficult to imagine a country as being better adapted to its native animals than North America was at that time to its bisons. Even now, notwithstanding the disappearance of these animals from the parts which have been settled and cultivated, the immense herds show that there is no falling off in the fitness of the country in those parts where the animals have not been invaded by civilisation. South America, too, which appears never to have had any ruminant animals save the lamas and alpacas of the more alpine districts, has proved, by the vast extent to which the cattle introduced by Europeans have multiplied in the plains, to be well suited for these animals, while in the greater part of Europe, and also in many places of Asia, the numbers of these animals in the wild state, have certainly been diminishing, in situations where they cannot be supposed to have vanished before the progress of population and culture. The unavoidable inference is that, in Europe and great part of Asia, seasonal changes have taken place, and taken place without any geological catastrophe of which we can find a trace, or even a single circumstance which we can twist so as to render such an occurrence probable, or even possible, to which nothing analogous has taken place in America. The bisons of the two continents are, no doubt, not the same species. But if deviation from the character of the common ox, which has accompanied civilisation and prospered along with it, is to constitute a species, the peculiar characters of the American bison, as deviating farther from those of that animal make it of the two the more characteristic of a different state of the country. The field for speculation in progressive natural history, which the consideration of these animals would open up is both wide and curious; but the data are few, and it comes not within the scope of a popular work in any other way than as a subject to which attention may be profitably directed. We shall, therefore, only further remark here that those species of the genus *bos* which have been sometimes classed and described as bisons, and which are all natives of south eastern Asia, partake more of the characters of one or other of the remaining groups of the genus *bos* than they do of those of the true bisons, whether we consider the eastern species or the American as the most typical.

BISTON (Leach. *Amphidasis*, Treitsehke, Duponch). A genus of lepidopterous insects belonging to the family of the *Geometridæ* or *Loopers*. The body is much more robust than in the generality of the family; indeed this circumstance combined with the strongly feathered antennæ in the males might easily lead the tyro to arrange the insects composing the genus amongst the *bombycidæ*, or feathered full bodies, as they are called; the females, however, have the antennæ quite simple; the palpi are very short and clothed with minute hairs, the spiral organ usually termed the tongue is very short, the thorax is stout and very woolly; the wings, which exist in both sexes, are of small size compared to the robustness of the body. The caterpillars which are decidedly loopers or geometers (moving along with a motion somewhat like that of a pair of compasses alternately opened and shut) have ten legs; they are long, cylindric, and more or less covered with warty excrescences, which give them the appearance, when stretched out at length, of a twig of the trees upon which they feed; the head is flattened and somewhat notched in front, and the chrysalis is not enclosed in a cover. This state is passed under ground. The type of the genus is the oak beauty moth, *B. prodromarius*, a handsome and not uncommon species, measuring nearly two inches in expanse, having the wings of a whitish colour, freckled with dark brown, the upper pair having two irregularly waved bands of reddish chocolate edged with black. It appears early in the spring. The other species included by Stephens and Duponchel are *B. betularius*, the peppered moth, and *B. hirtarius*, the brindled beauty.

BITTACUS (Latreille). A curious genus of neuropterous insects belonging to the family of the *Panorpidæ*, having for its type the *Panorpa tipularia* of Linnæus. The wings are long and narrow, four in number, of an equal size, and carried when at rest horizontally upon the back; three ocelli; antennæ very slender; the abdomen is long and slender, and nearly alike in both sexes; the males not being armed with the remarkable claw which is so peculiarly characteristic of the genus panorpa, and which has suggested the name of scorpion-flies for the insects of that genus. The legs are long, and terminated by a single tarsal claw. The species are very few. In all, however, there is exhibited the same striking resemblance to the dipterous tipulidæ, which is commemorated in the name of the species serving as the type of the genus, and which is an inhabitant of southern Europe. We believe that nothing is known respecting their habits.

BITTERN (*Botaurus*). A genus of birds, usually included in the order *Grallidæ*, yet not much in the habit of wading, though they are frequenters of marshy places, and dwellers and nestlers in tall aquatic herbage.

In the systems of ornithology, these birds have been very generally classed with the herons; but their appearance, their structure, their habits, and their whole characters are so very different from these, and indeed from all other birds, that there are few genera in the class which admit of more distinct definition and description; and their affinities or points of resemblance connect them much more with the rails or gallinules than with any other race.

They are birds of peculiar manners and haunts, and therefore they are characteristic of peculiar states of those districts in which they are found. They shun the abodes of man and the places which he improves by his culture; not merely the corn field and the rich meadow, but the coppice and the wood; and if the habitation of bitterns is surrounded by planting, the birds take their departure: neither are they ever found in the natural forests, unless where these are interspersed with marshy pools margined with tall and close aquatic herbage. There is no music for the bitterns' ear in the songs of the groves; and even if the air is free and fine enough for the sky-lark, the bittern comes not there. Nay, the nightly monotonous cry of the corn-crake: similar as the birds are in their appearance and in many of their habits, the bittern comes not to those moist fields and meadows where it is heard. The wail of the lapwing, the whistle of the plover, the scream of the curlew, and the bleating of the snipe, are the only voices of birds in chorus with which the bittern will join its booming and somewhat dismal sound. And with the exception of the snipe, even these dwell in the neighbourhood of the bittern, and not in its immediate haunts. In the mode of their inhabiting, more especially in the breeding season, which, in the case of all birds, may be regarded as the most characteristic one, there is more resemblance between the bitterns and the snipes, than between them and any other birds. There is also a considerable degree of resemblance in the outline of the body, and in the tints and even the markings of the plumage; though the brown on the bittern is more inclining to red, and comes nearer to the general hue of the corn-crake than that of probably any other bird. The feet also indicate a bird something intermediate in its haunts between the snipes and the corn-crake. The tarsi are long, the tibiæ bare for some distance above the tarsal joints; and the whole structure and articulation of the legs, and the bearing of the axis of the body in nearly a horizontal position, indicate considerable swiftness in running. The toes are not so long as those of the crake, and they are longer than those of the snipes, and more free to their bases; the hind toes in particular are very considerably longer than those of the snipes. The whole foot indeed indicates a walker upon herbage which is elastic, rather than upon the bare ground; and though the anterior side of the tarsus and the upper sides of the toes have their scales of that form and arrangement which are characteristic of a defence against humidity, yet the foot is not so much of a wading foot as that of many birds which have their nesting places much farther from the water than the bitterns.

The generic characters of the bitterns are: the bill to the bottom of the gape about the same length as the head, moderately thick at the base, but compressed or higher than broad; general section four sided, but rounded off in the culmen, nearly straight, and tapering to a very sharp point; nasal grooves very shallow, nostrils near the base, and half shut by membrane; a small portion of naked skin reaches from the gape to the eye; and the whole bill is exceedingly firm and hard in its structure. The legs are long, though not so much so in proportion to the size of the birds as those of the herons, but they are stouter, and altogether better formed for walking, the outer toe is connected with the middle one by a membrane which is merely rudimental. The wings are of moderate length, shorter than those of the herons; and the birds use them much less in their ordinary habits. The tail also is very short, and there are not on the sides of it, or on the lower part of the back, any of those produced and flocculent feathers which are characteristic of most of the herons; neither have the bitterns any flowing crest, though the feathers on the hind part of the head are much produced, and give the line of the crown a very peculiar straightness, which is not observable in almost any other bird.

The neck is long, but it is more robust in proportion to its length; and it looks more robust than it really is from the feathers upon it being much produced and loose, from which circumstance alone one might infer that it does not subsist so much by fishing as the herons. The neck is also borne very differently both on the ground and during flight. When the heron flies, at least on its longer flights, it carries a fold of the neck upon the shoulders; and it does not under any circumstances rear the neck into a straight line, unless when it stands up, raises the general axis of the body into the same position, and stretches the wings. When it is waiting for its prey close by the banks or in the shallows (for it walks little and uses the wing if it has to shift more than a few yards), the heron has the neck bent in contrary flexures. The shoulders are round, and the curvature of the neck continues till the upper part is as low as the under line of the body; then the neck folds back upon itself till it is rather higher than the turn of the wing; and the neck then bends downward till the point of the bill is below the under line of the body, and in a position nearly at right angles to the axis.

It is necessary to attend to this mode of bearing the neck in the heron, and contrast it with that in the bitterns, in order to arrive at an accurate knowledge of the habits of the latter bird. This is the more necessary that the two have been very generally described as different species of the same genus only; and though, in the case of birds of which the habits are especially open to common observation, this is a matter of minor importance, yet in the genera under consideration this is far from being the case. The heron is neither a shy nor a hidling bird. It nestles in trees, and may, when it is perching or rather standing upon the tops of these, be closely approached and attentively observed. Also, though it is rather more shy when it feeds, it is always visible on its feeding ground. It fishes in the shallows, but generally where the beaches are clear, and not where they are rank with herbage; and the constant readiness in which it holds its wings, prepared for flight, would be inconsistent with a footing among tall herbage: and it is to permit of this ready action of the wings, that herons stand on the tops of the trees, or rather rest on them in such a manner that their wings shall be clear of the twigs and leaves when they stand up.

Wherever there are herons, all their actions are thus easily seen; and though they are not so numerous as when there were more undrained pools and marshes, and consequently more brooks and streams, or at all events more water in them, and indeed a moister state of many parts of the country than at present, they are still not rare. But bitterns are not only very rare, but very seldom seen even where they are known to exist; so that there are comparatively few persons in a country so cultivated as Britain (England especially), that can obtain a sight of a living bittern; and still fewer that can obtain any personal knowledge of its habits. Therefore classing and describing the bittern as a species of heron must of necessity lead to very false notions of its character; and as that character is as singular and curious as the knowledge of it from personal observation is difficult, the prevention of mistakes regarding it becomes the more necessary.

Now, the different bearing and action of the neck in the two birds, is sufficient to prove that there must be considerable difference both in their food and in the manner of their obtaining it. The neck of the bittern, measured from its first articulation, is nearly as long in proportion as that of the heron, that is, about as long as the body. But when the bittern flies, the neck is stretched out; when it walks, it is borne upright, with the line of the forehead and bill horizontal; and when the bird reposes, which is always among tall herbage on the ground, and never upon trees, the position of rest is the neck erected, and the bill in the same line with it, or with the tip pointing to the zenith.

Thus, while the bill of the heron is held in readiness to act *below* the plane of the body, that of the bittern is held ready to act in the same plane, or above it; for when it is at rest, the neck is so far bent, that the bird can strike upward with the bill. The observation of the heron is thus also from the position of the head, below it, that of the bittern around and even above. This position, both of the bill and the observation of the heron, agree with its habit as a fisher; but the different position of both in the bittern, cannot agree with the same habit; and therefore, the classification of the bittern with the herons, and the interpretation of its unknown character by means of their known ones, which is inseparable from the classification, must lead to error, and error which, from the difficulty there is in actually observing the bittern, is not easily corrected.

No such conclusion as that the heron feeds chiefly upon fish and the bittern upon insects, mollusca, and aquatic reptiles and their spawn, can be drawn from the qualities of the flesh of the two genera; for though there is a difference, and the flesh of the bittern is described as more resembling that of hare, and the flesh of the heron more that of pheasant, though tougher; yet that of the heron has little of the rank and oily flavour, which, in aquatic birds, is usually denominated *fishy*. It would seem that it is not feeding on fish, but feeding on *sea-fish*, and partly also on water beetles, which gives this peculiar rankness to the flesh of birds; and though this is not a point upon which any certain conclusion can be arrived at without much previous observation and experiment, yet it is not improbable that the rank flavour is, in no small degree, owing to phosphorus and sulphur (especially of the former) in the food. The science of ornithology is still, however, too much in its infancy for admitting of a satisfactory conclusion upon such points; and yet, in so far as the economical use of birds is concerned, they are points of no minor importance.

In so far, however, as bitterns are concerned, the importance in an economical point of view is not great. The flesh of the common bittern is no doubt in request for the tables of the luxurious; and when a bird can be obtained, which is but rarely, it sells for from half-a-guinea to a guinea. This is, no doubt, in part owing to its rarity: but it has a rich and rather an agreeable flavour.

But a "bittern preserve" is amongst the last possessions for which luxury can hope, and it is also among the last which the friend of mankind would desire to see. The cover which man can produce artificially, may answer for the pheasant and the partridge, and also for the hare, as a substitute in flavour for the bittern; because, in proportion as man drains and improves the ground, and shelters it by planting, the food of these animals becomes more abundant. Even the heron may multiply in proportion as man increases the number of his fish ponds and his woods —for these voracious fishers, though they come to such places chiefly in the grey dawn of the morning, and retire by the time that the heat makes the fishes still, will come to the mill-pond, or even to the pleasure-ground near the dwelling-house, if there is a fish-pond there. But the bittern loves the seclusion of wild nature; and no known temptation will bring it upon the cultivated or improved lands as a permanent resident; and when the scarcity of the winter forces it from the upland, it appears to come down reluctant and stealthily; and seeks those streams and banks which are in the rudest and least improved state. The bittern, as already said, does not like trees; and it is never found by those waters which have either pebbly beaches, or a sod of rich grass down to the water's edge. Some of the running birds come to the beaches in the winter, and the goose and swimming duck tribes to the grassy banks; but if the soil is rich enough to bear even flags and reeds, it is shunned by the bittern. The bog-bent and the rush are the favourite plants with this bird; and it is fully more true to them than the cross-bill is to the pine forest. These are plants which very few insects inhabit, and which we do not often find eaten by any creature; and therefore, remaining in them, the bittern cannot be very insectivorous. Horse-leeches and the smaller grey slugs are, however, to be met with in the vicinity of these plants; and both the species which have been mentioned, have those parts of the young roots which are in the humid earth and blanched, very albuminous, and very sweet to the taste. These could easily be dug out by a much less efficient bill than that of the bittern; and as they do not require trituration in a gizzard, as is the case with most seeds, the fact of the bitterns having only membranous stomachs, and very short cæca to their intestinal canals, is no good argument against their feeding on the roots of those plants. Indeed, in those places which appear to be preferred by them, if they do not occasionally feed on these roots in the winter, it is very difficult to imagine on what they can feed. Fishing, by any wading bird, even if we are to suppose the bittern a wader, is out of the question at the season alluded to. There are few fishes in those places at any time of the year; and even the herons quit the upland brooks, and retire to places which are warmer before the intensity of the winter sets in. It is possible that when the bitterns descend the streams, they may eat the spawn of those fishes which deposit it in such places in the end of autumn and the early part of winter; but when they descend they follow the rushes, and other herbage which is firmly rooted; and these are not generally the depositories of the spawn of fishes.

In summer, so far as the observation of the writer of this article has gone (which has, however, been chiefly where the moors were very bleak and bare, with the bittern pools on the very summit, or at all events at the water-shed, where there was only a small pool for the wild goose in the winter, and the aquatic plants equisetums not reeds, with broad margins of hummock and rush, and then hard bent outward to the heather,) the heron never ascended so high as the abode of the bittern; and though one cannot speak with so much certainty of the marchings of the bitterns, as they are both hidling and silent, except during the breeding season, yet they were not observed so far down the streams as the places occasionally frequented by herons, unless when "frozen out" at their native places.

Thus, in whatever point of view we consider them, bitterns are a very singular race of birds,—peculiar in their habits, and characteristic of a very peculiar state of the countries, or at all events the districts, in which they are found. They are, as it were, the children of desolation; and they hide themselves there, and will not be either enticed or driven to better pastures; nor can they be made in any way to accommodate themselves to, or partake in, the improvements which are made by man, or even in those which take place from natural causes.

Improved places of the latter description are found only among the mountains; and even there the course of nature is more frequently the reverse: the transition from grove or copse to peat-bog, and the consumption of heath by moss and lichen. There are, hovever, some instances of natural improvement; a flood of more than ordinary strength and duration, will sometimes break down the natural dam which retains the stagnant water, wash away part of the miry soil, and drain the remainder; and when this takes place, the subsequent rains wash down sand and more kindly particles of earth, and the seeds of the mountain grasses and little trefoils come along with them; till in time the erewhile swamp is changed to a green and wholesome pasture. Nor are there wanting instances in which, from some such natural change as this, though these are far less frequent than changes of man's making, the blithe carol of the skylark succeeds to the dreary boom of the bittern.

There is not, in many of their habits, and especially in their voices, a more striking contrast among our native and resident birds than the skylark and the bittern; and yet, when we come to examine them closely, we find more points of resemblance between them than we would be prepared to expect. They are not, upon the whole, very like either in shape or in size; but the outlines of the heads and the marking of the plumage have some similarity. Their food, though different in species, as being found upon soils very different from each other, yet belongs to the same general class of substances, especially during the nesting time, which is the truly characteristic time of all birds. Skylarks are usually classed among the vegetable feeders; but that applies chiefly to their food during the winter, when the majority of our resident birds which do not either resort to the shores, or feed upon the tops of heath or moss, like the mountain gallinidæ, will then feed on the seeds with which the ground is strewed, or on the berries on the bushes. In summer, the skylarks feed more upon animal matter; and their general feeding brings them more within the division of omnivorous feeders than any other; we have said, and though it is not proved it is probable (and much of the history of bitterns is eked out with guesses), that bitterns must either have long fasts, or live partly upon vegetable food in the winter. It is further worthy of remark, that the skylarks do not flock in the greatest numbers to the places which abound most in annual plants and their seeds, but to those which abound most in the common red earth-worm. Thus, there is a similarity in the seasonal food; only the lark frequents places where the soil is dry, and the vegetation kindly, and the bittern humid places, where the vegetation is harsh.

There is also some similarity in their feet, though the one bird is fitted for running among the dry clods or upon the grassy sod, and the other for the rushy hummock, or the stiff bent, and the stiffness of the bittern's footing does not require the same elongation of the hinder claw.

Even the voices of the two birds, different as they are in the place, the hour, and the sound, have still some resemblance in the way in which they are delivered. Both birds deliver their song only when they are on the wing; both ascend the air in spirals; and both sing loudest at the top of their flight. There is even some resemblance in the time (of the day) at which their very dissimilar notes are begun. The lark begins at grey dawn in the morning, the bittern at grey twilight in the evening; and while the one is never known to sing when the sun is below the horizon, the other is never known to sing when the sun is above it. They both agree in singing only when the air is tranquil, or at least when the wind is very light; and they both agree in singing most blithely (if blitheness can be predicated of both) when the air is in that relenting state, which does not severely dry the surface, and therefore brings out the small earth animals on which they feed. An unusual vehemence in either of their songs is thus an indication of rain, or at all events of what is called "soft growing weather."

But notwithstanding these very curious analogies, it is equally curious to observe how much the strain of each bird's voice is in accordance with the place where, and the time when, it is heard. The song of the skylark, is given over fresh and fragrant fields coming into bloom; for even at the earliest time that it gives its full stave, the daisy has bloomed on the sward and the coltsfoot on the lea; and it is given as the matin song of those places of hope and promise; the awakening call for all nature to arouse to enjoyment. The lively song of the lark, is therefore in admirable keeping with the time and the circumstances, and they and it give reciprocal effect to each other. Nor is that of the bittern less accordant. It is heard only as the evening twilight begins to deepen the gloom of the wilderness, and the few prominent objects which mark its dreary surface put on a spectre-like appearance. Then, though the air is tranquil at the height to which the bittern wheels, there are little winds in motion between the dry moor and the bog, which cause a rustling among the withered stems which have outstood the winter, as if some unseen creatures were moving to the sound of that dismal voice which is shaking the sky, and grating on the ear till the whole body quivers, and the earth feels as if it were unstable and quaking at the sound. The popular name given to this very singular sound is "booming;" but neither that nor "bellowing" like a bull, from which the genus has been called *Botaurus*, nor any other single epithet, is accurately expressive of it. Nay, it is by no means easy to imagine a compound, which can convey anything like an accurate notion of the bittern's voice to those who have not heard it. Think of a full chorus of bulls, horses, asses, turkeys, and geese, driven forcibly from their repose, amid the loud shouts and wild laughter of banditti; and perhaps the approximation might be as near as most others.

Sir Walter Scott, whose extraordinary powers of observation and description were as true to nature generally as to the characters of human beings, has described and discriminated the skylark and the bittern with very graphic effect, in the serenade which Helen sings to Fitzjames on the island:—

> "But, the lark's shrill pipe shall come,
> "At the day-break, from the fallow;
> "And the bittern sound his drum,
> "Booming from the sedgy shallow."

Small critics might, perhaps, take some exception to the juxtaposition of these; but there is no violation of nature in this,—the lark may begin to sing before the bittern gives over.

These general remarks have extended to so great length, that we must shorten considerably our notices of the species; and we do not require to be very detailed with these, as they are all obscure, and all bear considerable resemblance to each other. The species which is best known in Britain, though it probably never was a plentiful bird, and is now a rare one in all places, and unknown in very many, is,

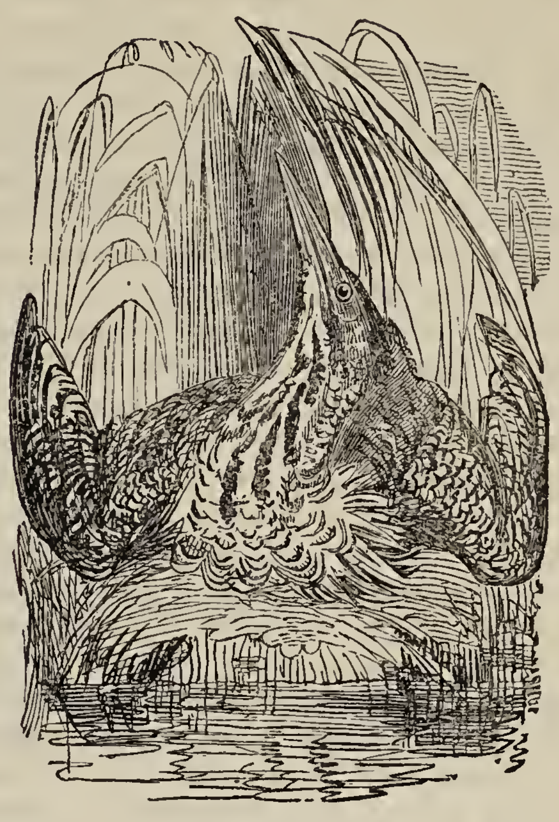
The Common Bittern (*Botaurus stellaris*). This is the species chiefly alluded to in the former part of this article, and the one, indeed, from which almost all the general descriptions of the genus are taken; and then, in most instances, it is, as has been mentioned, considered as a species of heron, under the name of *Ardea stellaris*, and the generic descriptionis confounded with, or merged in, that of the common heron, as the type of the genus *Ardea*.

The length of the full-grown male is sometimes two feet and a half, but generally rather less; and from the length of the legs, and the length and erectness of the neck, the height to the top of the head, when the bird stands up, is nearly equal to the length. When the length is two feet and a half, the stretch of the wings, from tip to tip, is nearly four feet, and the proportion is preserved in full grown specimens of whatever size. The wings thus bear nearly the same proportion to the length of the body as those of the heron, but they are not so well feathered, and both they and the bird altogether are heavier in proportion to the lineal dimensions. It is not, however, so much the want of wings which renders the bittern so much less a wing bird than the heron, but the difference of its food, and especially of the places where that food is found. When it takes its wheeling flights in the manner which has been described, it flies, not very rapidly certainly, but still with firm wing, and it turns very smoothly and gracefully. It is capable of taking pretty long migratory flights, though it flies high and silently, and is seldom observed during them. Indeed, it is probably more of a migrant than is usually supposed; for when cultivation makes it disappear from those places which have been its haunts, we are not to suppose that it perishes, as we do not find the bodies or the bones of dead bitterns in the wilds when we begin to lose the sight and the sound of living ones; and thus the fair inference is, that it is capable of removing to a new haunt, even though at the distance of many miles.

The lofty flight which those birds, which frequent only very peculiar places, take when they are once fairly on the wing, answers other purposes than that of being in a rarer medium, and one in which the currents of the air are much more steady than they are nearer the surface. They are more out of the reach of their natural enemies, which are principally the harriers, buzzards, and other low-flighted hawks, and they command a wider horizon, and find out more readily the places where it is most advantageous for them to alight. When, however, they are settled in a locality, their flights are low and short, and if either the sportsman or their winged foes can succeed in raising them, they become a more easy prey than many birds which are far less powerful. Thus the common snipe costs the peregrine falcon more trouble, and so does the lapwing the jer-falcon, than the bittern costs the moor buzzard, if the buzzard can keep it on the wing.

The wing is not, however, the bittern's means of escape from its enemies, especially where it nestles and inhabits. Its feeding time is in the twilight of the morning and evening, and probably during the whole of the night, when the moon shines clear, or where the place is so far to the northward as that a bright twilight continues all the night. This last circumstance may, indeed must, be one of the reasons why those birds which feed in the twilight have in general a tendency to move polarly in the summer. The more northerly, in our hemisphere, the longer the twilight, and therefore the longer the portion of each day during which they can procure food for themselves and their young at that season when they stand most in need of it.

Even when not upon the nest, the bittern squats among the rushes, or other tall stems, during the greater part of the day. The mode of squatting is rather peculiar, and may be understood from the following figure.



Bittern.

The neck, when the head is in this posture, is raised, and the point of the bill directed upwards, the body and legs being, at the same time, in such a position that a violent thrust may be given by the bill, if necessary; and as the neck is powerful, and at the same time readily moveable in such a manner as to secure the whole body from attack, there are few birds of prey that would venture to descend upon the bittern in this position, even if they should see it; and its form is so unlike that of any bird in a common attitude, and the tints of its plumage so like those of mud and half-withered herbage mixed together, that it is not easily seen; while, from the elevation of the head, and the position of the eye, it readily commands the whole horizon around it. If it is attacked, its first attempt is to transfix the assailant, by receiving it on the sharp point of the bill, or by an upward thrust with that instrument. If it fails in that, it alters its mode of warfare, by throwing itself on its back, and fighting desperately with both bill and claws, and it is so strong, and so ready in the use of these, that it makes a very stout resistance.

The common bittern is widely distributed, being found in Europe and Asia, and also in America; and this general distribution would of itself lead to the conclusion that the birds are capable of migratory flights. In every part of the world, however, they are rarely to be seen, though in all places where they breed they are pretty certain of being heard about the commencement of the breeding time.

The particular characters of this species, besides the dimensions as already stated, are: the bill, from the tip to the hollow of the gape, about four inches, or nearly so, in length (which, from its form and the firmness of its substance, makes it a very formidable weapon), and it is of a dark colour for the greater part of its length, but greenish at the base of the lower mandible. The naked skin at the gape, and the naked parts of the legs, are nearly of the same colour, but the legs have a very slight tinge of a reddish hue along with the green. The feathers on the forehead and crown are black, but the general colour of the clothing feathers is yellow, with more or less of a reddish brown tinge, and very finely spotted and barred with black; and it is from the number and regularity of the spots that it gets the name of *stellaris*, or "starred." The greater coverts of the wings and the quills are more inclining to rust colour, and more thickly and regularly barred with black than the general plumage of the body. The tail is very short, but the closed wings do not reach to the extremity of it. The toes and claws are long, and both rather slender, though the claws are sharp pointed. The claw of the middle front toe is slightly toothed on its inner edge. These are the characters of the male. The female is smaller in size, and the colours of her plumage are not so bright.

The common bitterns feel the influence of the season rather early. The love song of the male begins early in March, and sometimes even in February, but that depends on the season and the locality; and it is sometimes begun and continued for a few days, and then left off for a week or more, in consequence of that short supplemental winter, which is pretty regular, as well as severe, in those wild places which bitterns most frequent, and known by the name of the "Lapwing Storm," as these birds and it very frequently come about the same time. When this storm, which is never of long continuance, and is often unknown in the low and warm places, or is merely a bleak wind there when it is snow upon the bittern's habitation, is over, the harmony of the bittern begins anew. It is hardly necessary to say, that the once popular notion, that this sound is produced by means of the bill thrust into the quagmire, and aided by the vibrations of that in the jarring sound, is without foundation. Of all imaginable places, a quagmire covered with rushes and other rough herbage, such as that which bitterns frequent, is the least sonorous, or capable of producing, or aiding in the production of sound of any kind; and whatever the note of a bird may be, that note is never produced, or even much modified, by the bill, or the upper end of the trachea. The real organ of voice in birds is always at the bronchial end of that canal, and not at the larynx, or upper end, as in the mammalia. In consequence of this structure, the whole of the trachea is converted into a sort of wind instrument, by which the sound, of which the lower end is the more immediately, or originally producing organ, is modulated in the same manner as the voice of the mammalia is modulated by the palate, tongue, and mouth. Of course the sound which birds emit varies with the length and form of the trachea, and, just as is the case in the sound of artificial wind instruments, the sound, whatever may be its original quality, is rendered deep and hollow in proportion to the length and size of the trachea, whether the additional length be produced by convolutions of that organ, or by a greater length of the neck. When there is a shaking sound, there is of course a vibrating membrane in the original organ of voice; but whether that shall produce a sharp and clear trill, as in the warblers, or a grating and hollow sound, as in the bittern, depends partly upon the structure of the membrane, and partly upon that of the trachea. Some further observations on this subject will be found in the article VOICE.

When the male bittern has continued sufficiently long at the exercise of his music, such as it is, for "winning the favour of his dame" (for such is the object of his to us unseemly music), the two, in concert, set about preparing the nest—that is but a homely structure—a rude couch of withered grass or rushes, placed on a hummock, where it is well concealed, or upon the short stump of an aquatic shrub, if there happens to be one in the nuptial demesne of the pair. It is never far from the water, because the birds do not range out of the humid places; but it is always above the "rise" of any ordinary flood which can take place during the time that it is in use, and it is always formed of dry materials. All nests, indeed, are so, though there has been mention made of some aquatic birds taking advantage of the fermentation of green or moist vegetables, and the heat thereby produced, to assist in the hatching of their eggs. But the action of water would, even in this way, destroy the principle of life in the eggs, instead of maturing them; and therefore, even those eggs which are committed directly to the waters, are so defended by their peculiar tunics, that the water has no direct chemical action upon them.

The eggs of the common bittern are generally four, though, as is said, they are sometimes five, and they are of a greenish brown colour. The nest is, however, as rarely seen as the birds, because, though, in the early part of the season, the male is noisy enough in the air during the evening twilight, both birds are remarkably silent during the day, and they are always silent when they are at or near the nest.

The period required for rearing the young is little short of seven weeks, about twenty-four days of which are spent in the hatching of the eggs, and three weeks in feeding the young in the nest. The young differ much from those of the true grallidæ in the length of time which they require before they are able in any way to shift for themselves. The young of the true grallidæ, though covered with down, and not feathers, when they come out of the shell, are very soon able to run, and in this respect they have some resemblance to the gallinidæ; but those of the bittern are callow and almost naked, and at the same time scraggy and skeleton-like in their form.

The common bitterns live at all times solitary, or at most in pairs, and never flock, or even congregate together in families; and as soon as the young are able to shift for themselves, they follow the habit of their parents, and are not seen together till they pair and have families. With the exception of the love-song, which is not long continued, the birds are quiet, and they are quite inoffensive, and never attack or annoy any creature save those small animals which constitute the greater part of their food. In their chosen habitations there are, indeed, few animals with which they can quarrel, even were they so disposed; and as we have already seen, it is not very safe even for birds of prey to quarrel with them. Nor are they powerful in defending themselves against birds of prey only, for they offer formidable resistance to dogs; and if the dog is not all the more staunch, he will hardly go in upon the bittern if he gets a thrust from the bill. Even the sportsman, when he only wings the bird, or lames it so that it cannot escape in the ordinary way, but yet retains the greater part of its strength and spirit, must approach it with caution. It strikes so fiercely with the bill, that it can wound the leg through a thick boot; and if it can strike any part of the body which has not such a protection, the wound which it is capable of inflicting is very severe; and thus, while it never invades the haunts of man, man does not invade it in its haunts with impunity.

The Little Bittern (*Botaurus minutus*). This is a much smaller species than the common bittern; but it appears to be better winged in proportion to its size, and it is much more discursive. It belongs to what may be called the eastern migration, or to that of those birds which range along the line of the Asiatic rivers which empty themselves into the lake of Aral and the Caspian, and the European rivers which empty themselves into the Black Sea. In its structure, especially that of the head and neck, it bears a much closer resemblance to the smaller herons of the eastern migration than the common bittern does; but still its prevailing characters are those of a bittern.

Birds which come into the British islands upon any of the lateral migrations, of which those of the eastern one are most numerous, from the narrowness of these which they have to cross. Most of the aquatic birds which straggle into Britain on this migration from the east, come by the lines of the Danube and the Rhine. As they retire westward from the marshes on the lower Danube, and the other rivers which fall into the Black Sea, whether they merely disperse for nesting places, as is the habit with some birds, or are driven from those places where the water becomes low before the autumnal rains set in, they are divided into two sections by the Carpathian mountains; but as the northern section have their progress arrested by the dry sandy grounds of western Poland and northern Germany, there are comparatively few of that division which reach the shore of the north sea, and consequently fewer that find their way to Britain. Those which come by the lines of the central rivers, have an uninterrupted pasture all the way; and as the countries on the lower part of the Rhine are, from their flatness and humidity, well suited to the habits of such birds, they are plentiful in Holland, and find their way to the marshy portions of the north-west coast of Germany in that direction, and not by the more northerly, and, geographically speaking, more direct route. It is on this account that those wanderers are more frequently found in England than in Scotland; but though generally, they are not always found on the eastern shores. The breadth of the island is not a very serious journey for a migrant, when it is once on the wing, as there is perhaps no bird which, on its high and long flight, makes way at the rate of less than thirty or forty miles an hour. Many of them appear to fly much more slowly than this; but it should be remembered that this is an optical deception produced by the height at which they fly; and if we do not take this into the account we are sure to conclude that their motion is much slower than it is in fact.

It will readily be understood that the apparent motion of a bird flying, or indeed of any other moving object, must be lessened by distance in the very same proportion that its lineal dimensions are diminished; that double the distance, for instance, will reduce both the apparent size and the apparent velocity to one half, and the same in proportion for all other distances. This, though it is seldom noticed in popular works on natural history, is a very important consideration for the observer of nature; and in the case of birds especially, the most erroneous estimates of their rates of flight will be made, if distance is not taken into the account, and the effect which it has in diminishing the apparent rate. The motion of the sun, which though only an apparent motion as regards that luminary, is the exact counterpart and consequently the exact measure of the motion of the earth. Now this apparent motion of the sun appears, in consequence of the vast distance of that luminary, so slow and lagging that we can hardly perceive it; and yet is more than two thousand times faster than the swiftest light carriage that ever steamed along the Liverpool and Manchester railway. If distance can reduce so tremendously rapid a motion as this —a motion which would not only dash into atoms any two masses of any known substance, if they were to come into collision at that rate, but which would instantly kindle and dissipate into their constituent gases two globes of ice; then we can easily understand how distance will deceive us in the flight of birds at different elevations. The swift at steeple height, appears to us to move more slowly than a barn-door fowl; and yet it will make a turn round the churchyard in the time that the fowl takes to flutter across the pathway. Wild geese too, seem to get on very slowly; but they very soon clear the horizon, or pass along that space over which they are visible, which to a good eye is at least two or three miles. We are of course liable to fall into the same error when we look at any birds on their elevated migratory flights; and by not making allowance for the optical deception stated above, we are apt to wonder at the effort made by such a bird as the little bittern when we are told of its alighting in those places of the British islands which are remote from its native localities; whereas, in truth, the stretch across such an island as ours, is no more fatigue to the bird than those walks which we take, absolutely for the purpose of refreshing (that is, *resting*) our limbs, are to us.

The little bittern is about fifteen inches in length, and two feet in the extent of the wings. Its bill is about two inches long, brownish-horn colour at the tip, and partly along the ridge, but greenish yellow at the sides and the base. In form and colour it is a more aquatic bill than that of the common bittern; and the neck is more borne in flexures. The feet are dull green, and the feathers on the tibiæ reach down to the tarsal joints, which shows that it is not much of a wader; and also that though it may find more of its food in the water than the common bittern does, it does not frequent such moist and tangled places during its walks. The feet are otherwise formed like those of the common bittern, and, as in that, the inner margin of the middle claw is slightly serrated. It is a much more beautiful bird than the common bittern. In the male, the head, upper part of the neck, back, and tail are glossy black with green reflections; the chin, throat, and breast are buff colour, and the rest of the under part is white. The scapulars are relieved by a chesnut-coloured spot; the lesser coverts are buff; the larger whitish, and the quills black without any gloss of colour. The female is smaller than the male, and so differently coloured that it has sometimes been described as a distinct species. Where the upper part of the male is black with reflections, that of the female is brown with rust-coloured margins to the feathers; and the buff on the under part is much paler, and appears chiefly on the margins of the feathers.

Of the few specimens which have been observed in this country, some have been found perching on the stumps of trees by the margins of rivers, and others in places where there are no trees, or even stumps upon which a bird can perch. It does not appear however that the birds builds on trees, or that it even rests on their tops like the heron. The nest is said to be in the cover of a bush or tuft, and rudely formed of the dry leaves of the aquatic plants. The eggs of the same number as in the common bittern, but nearly white in the colour.

The American Bittern (*Botaurus lentiginosus*). This species is a native of America, over the northern part of which continent it is pretty generally distributed. In form and in the general tint of its plumage, it bears no inconsiderable resemblance to the common bittern; but the spots and markings of dark colour are much more minute and thickly spread, on which account it gets the epithet "*lentiginosus*" or "freckled." This species is said not to ascend and boom in the pairing season, in the same manner as the common bittern; but it makes a hollow drumming noise when it is disturbed.

On the continent of America, this species is very migratory. Indeed, from the intense cold of the winter, even in latitudes which are not very high, the great range of country, the abundance of water, and the warmth of those countries which border on the Gulf of Mexico, and which are at the same time very humid, abundant in cover, and in the food of all sorts of birds, but more especially aquatic and forest ones, and which are even at this time very partially cleared and very thinly inhabited, birds are far more migratory, and far more numerous on their migrations, than on any part of the eastern continent. From the moors of north-eastern Russia to Egypt is the only portion of the eastern continent, in which there is a migratory range from the one extreme to the other, without being actually interrupted by mountains; and even there, the path lies for great part of the way upon the sea, and the mountains approach so near on each side as to leave only a comparatively narrow gorge, while Egypt, as a water bird's country, though rich for its extent, is only a broad stripe seaming the desert. In America there is no such interruption; but from the swamps of Florida and Lower Louisiana, northward to the utmost extreme where a bird can find food, there is free range, abundant food, and congenial resting place for every way-farer on the wing. This ample scope, by means of which the seasonal action of nature plays freely from the polar to the tropical sea, is one of the causes of that great diversity of seasons, which renders it necessary that birds which live on the margins of the waters, and yet are inland and not shore birds, should move to the southward in the winter. But the very same structure of the surface which imposes this necessity upon the birds, finds them accommodation, and nearly equal accommodation, at every latitude of this wide range, so that they can shorten their journeys if the season is mild, or lengthen them if it is severe. On their northward journeys there is little chance of these birds ranging across the Atlantic to Britain; because at that time the southern part of the great central valley of America is warm, and the northern part cold, and the high flying birds get above the southward current of air, which sets near the surface of the ground, and float easily upon the upper or return one from the south, which at some elevation is the prevailing wind in the valley of the Mississippi, just as the south-west wind is, from the same cause and at the same season and height, the prevailing wind with us, even when the surface wind blows steady from the north-east.

It is not probable that the same individual birds, of the freckled bitterns or any other species, range the whole length of this vast district, which from the Gulf to about the middle latitude of Hudson's Bay is about two thousand miles. We must suppose that the water birds at all times inhabit a very considerable portion of the length, more especially the bitterns, which are at all times solitary birds, and do not flock even upon their migrations, as is the case with many species which dwell apart when they take up their seasonal abode. The species under consideration appears on the swamps near Hudson's Bay in the beginning of summer, and breeds there; but as it is a retiring bird, and as those swamps are not very accessible till they are frozen, before which time the birds have of course removed to the southward, comparatively little is known either of their numbers or their habits.

Besides the three species of which some notice has been given, there are others that have been described either as bitterns, or confounded with them in the melange of the old genus *Ardea*. The three which have been mentioned are, however, the only ones of which the history is sufficiently made out for popular purposes. As bitterns their story is soon told, being in all the three little else than a repetition of that of our native one. But as they are very pre-eminently birds of wild nature, the study of them in all the different habits of the species, is important, as they are in some sort keys, not only to the ornithology, but to the general state of nature in those places where they are found. We find the common one migrating but little, dwelling pretty generally over the globe, but only in very peculiar spots, and incapable of bearing much change in their physical character, by whatever cause that change may be brought about. We have the second much more discursive, not so resolute a feeder in the rough herbage, or so determined a dweller in the wild and lonely marshes only. It has a seasonal migration from east to west and back again, along the central part of the old continent; though to the eastward of the Caspian, it is probable that its motions are reversed in time as compared with those to the westward. In the last mentioned species again we have a migration nearly upon the meridian, in a bird which resembles more the first, or least migratory species, in its habits. But we have also seen that the country in which this last one takes its seasonal flights, is one remarkably well adapted for the support of birds of this tribe; and that, with the exception of being stationary in the same place from the time that the nest is begun till the young are able to shift for themselves, which takes place at the most northerly part of the annual movement, or when the twilights are longest and the food most abounds, and is more easily obtained,—the movement for the rest of the year is a gradual shifting from day to day, without any necessity for those long and laborious flights which the migrant birds that in general visit our shores are obliged to take across the sea. Many inferences from the hints which have been thrown out in the course of this article will suggest themselves to the reader: among others, that the migration of birds is not that mysterious matter which some have asserted, but that it is varied as much by natural circumstances, and therefore depends as much upon natural causes, as any other occurrence.

BITTER VETCH is the *Orobus* of Tournefort, a numerous family of the tare kind, mostly indigenous to Europe. The orobus belongs to the *Diadelphia* class and *Decandria* order of Linnæus, and to the natural order *Leguminosæ*. Generic character: calyx of five teeth, the upper ones shorter and deeply divided; style round at top, and downy; pod roundish. There are above thirty species of this genus divided into three sections according to the composition of their pinnated leaves—as one-paired, many-paired, &c. They are all pretty flowering plants: the *O. vernus* in gardens, and the *O. tuberosus* on our heaths, are universally admired.

BITUMEN. This term includes a considerable range of inflammable mineral substances. They are of different degrees of consistency, from a thin fluid to a solid; but the solids are for the most part liquefiable at a moderate heat. Bitumen, as we have already stated under ASPHALTUM, was formerly employed to a considerable extent in the arts of domestic life. The Egyptian, after the lapse of thousands of years, may still be said to preserve his identity in our museums by the agency of this mineral, and when the swathing clothes are unrolled many of the bodies have been found in a high state of perfection. Bitumen is either elastic or compact; the first of these is of various shades of brown. It is found in abundance in the Odin mine near Castleton in Derbyshire, in a secondary limestone.

Compact bitumen is of a brownish black colour; one variety may be impressed by the nail, and is called maltha; another is very brittle, and is in commerce called asphalt. On the banks of the Dead Sea, and in the neighbourhood of the latter body, is found a species of stone called "mussa" by the Arabs, which on attrition exhales an intolerable odour, and burns like bitumen. It is of a jet-black colour, and takes a fine polish. Maundrel saw pieces of it two feet square in the convent of St. John in the Wilderness. The inhabitants of that country employ it in paving mosques, churches, and other places of public resort. The natives of Bethlehem affirm that it is endowed with powerful antiseptic virtues, and bracelets of it are worn by attendants on the sick as an antidote against disease. Bituminous shale, which forms the Brandschiefer of Werner, is of a brownish black colour, and occurs in rocks of the coal formation, where it frequently alternates with and passes into slate-clay, and also into coal. It is also found in the coal districts of our island, and in several parts of the north of Europe. See PITCH, COAL, MINERAL.

BIXINEÆ. The Arnotto family. A natural order of dicotyledonous plants, containing six genera and upwards of twenty species. The order is by some included under the *Flacourtianeæ*. It is nearly allied to the *Cistineæ* and *Homalineæ*.

Its botanical characters are:—Sepals or leaves of the calyx varying from four to seven, with an imbricated æstivation; petals five, sometimes wanting; stamens indefinite, inserted on a disk; anthers two-celled; ovary superior, sessile, one-celled; style single, or in two or four divisions; fruit, a many-seeded, single-celled capsule or berry. The plants included in the order are trees or shrubs, generally smooth and having alternate leaves with pellucid dots. They are chiefly tropical exotics, found in the hotter parts of America and in the Mauritius. They are not remarkable for their beauty, or for the useful purposes to which they are applied.

Their properties will be best shown by the following examples:—The chief genus (whence the order is named) is called *Bixa*, a term derived from the American name of the plants. The red pulp which

Bixa.

covers the seeds of the *Bixa Orellana* yields the substance known by the name of arnotto. It used to be denominated *Terra orellana*, or *orleana*, and is called by the French, *rocou*. The seeds are separated from the pulp by maceration in hot water, and the pulp is then made into balls or cakes, which when dried constitute the arnotto of commerce. Good arnotto is soft to the touch, and dissolves entirely in water. It is slightly purgative and stomachic, and is used in Jamaica and other warm countries as a remedy for dysentery and disorders of the kidneys. Dyers form with it the colour called aurora, and when mixed with lemon juice and a gum it forms a crimson paint with which the Indians adorn their persons. By the Spaniards it is used for the purpose of adding to the colour and flavour of chocolate and soups. In Gloucestershire and other counties it is employed to colour cheese, and in Holland butter is dyed with it. The bark of the tree is made into ropes in the West Indies, and the wood is used for the purpose of procuring fire by friction. The other genera of the order are, *Ludia*, *Lætia*, *Prockia*, *Banara*, and *Azara*. The bark of *Ludia heterophylla* and *sessiliflora* has emetic properties. The azaras are Chilian shrubs, with fragrant flowers not known in the gardens of Europe.

BLACK-BREASTED, or TITHYS REDSTART (*Phœnicura tithys*. *Motacilla erythaca*, Linnæus. *Sylvia tithys*, Temminck.) This is a common bird in Germany, Prussia, and the east of Europe, becoming gradually more and more scarce towards the west, and in Britain has only been discovered very lately. It is about the size and shape of a robin; the whole upper parts to the rump are bluish grey; the base of the bill, region of the eyes, the sides of the neck, throat and breast, black, margined in the winter with greyish edgings, which gradually disappear in the spring; middle of the abdomen greyish white; flanks and sides blackish grey; quills blackish; the secondaries and tertials slightly margined with dull white; rump and tail bright reddish rust colour; the two middle feathers of the latter dark brown. In the female the whole of the body is of a uniform yellowish grey, the quills and secondaries being rather darker; the rump and tail as in the male bird, but not quite so bright.

The male may be described briefly to resemble the common redstart of this country, but is a trifle larger, and is without the distinct bar of white upon the forehead and the reddish brown plumage on the breast, which distinguish that species. It much resembles it also in habit, frequenting the vicinity of old trees and various out-buildings, old park walls, and the ruins of ancient castles, &c., but is considerably less shy in its disposition, and in the countries it inhabits plentifully may often be seen pouring forth its song from the roof of a house or from the garden-wall, occasionally darting off to snap at a passing insect, in the manner of the various species of fly-catchers. Its notes closely resemble those of the common redstart, but its song, though very similar, is more monotonous and tiresome. Its food also is the same, consisting of insects and their larvæ, the former of which are frequently taken on the wing.

All the redstart genus are remarkable for a singular manner of constantly shaking the tail. In the present species the shake is different from that of the common redstart of this country, which latter is a slower motion, gradually dying away in the course of three or four oscillations, each less than the preceding one, and appearing exactly as though the tail were loose, and ready to fall off. In the tithys redstart the oscillations are quicker and of less extent, not gradually dying away, but the last shake being fully equal to the first. These birds never alight on a spray without their tails moving in this singular manner, which gives them a remarkable and very characteristic appearance. The tithys redstart appears to build less in the holes of trees than the common species, but constructs its nest more in the clefts of rocks, in holes of walls, and in other similar situations, and is said to lay five or six eggs, of a spotless bluish white.

BLACKCAP (*Curruca atricapilla*, Brisson). A variety of small black-headed birds are designated in different parts of Britain by the term *Blackcap*. The great titmouse (*Parus fringillago*), the marsh titmouse (*P. palustris*), the black-headed or reed bunting (*Emberiza schœniclus*), the stonechat (*Rubetra rubicola*), and even the black-headed gull, are all frequently called by this name; but the bird which by naturalists is universally recognised as the blackcap is a species of fruit-eating warbler, or fauvette, abundant in most parts of Europe, and which extends its summer migrations even to the inhospitable shores of Lapland. Throughout Britain this is well known as a summer bird of passage, and is also one of the earliest to arrive, a few sometimes appearing in the southern counties about the middle of March, reminding us, by their charming melody from the leafless spray, that winter is on the wane, and summer and sunshine are at hand. It is a handsome species, though plain and unassuming in its garb; being black upon the crown; the back, wings, and tail, greyish olive, with the back of the neck and whole under parts pure ash-colour, paler on the throat, and becoming white upon the belly. The legs and feet are a dusky lead colour. The female is very similar to the male, only that the crown of the head is of a rusty hue; and the young of the year resemble the adult female, the young males, however, being rather smaller and darker coloured than the other sex.

The blackcap is undoubtedly one of the finest of British song birds, and in some counties of England is commonly known by the name of *mock-nightingale*, from the similarity of parts of its song to some of the notes of that celebrated bird. Sitting calmly, embowered in thick foliage, his bosom resting on a bough, he pours forth, without effort, a delightful flow of soft and pleasing melody; then suddenly elevating his voice, and raising the black feathers of his crown, he warbles aloud a cheering, liquid strain, for which, at least in these islands, he certainly stands unrivalled. There are few unacquainted with this note, though the blackcap does not always get the credit of it, some attributing it to the blackbird, and others calling it "the livelier summer strain" of the robin redbreast. It resembles the latter much more nearly than it does the blackbird's song, but may always be at once distinguished by its far more animated and lively tone, being without any admixture of that peculiar plaintiveness which ever characterises the song of the robin. There is something inexpressibly sweet in the common call-note of the blackcap to its mate.

The most favourite haunts of this bird are gardens and orchards, though it is abundantly found wherever trees and bushes grow together, passing most of its time in the former, and usually selecting the latter for nidification. The nest is sometimes placed near the ground, amongst the herbage, or at the bottom of a bush, but more frequently in a forked branch at four or five feet from the ground, and sometimes at the height of nine or ten feet. It is of a neat construction, composed of the dried stems of grass, often put together with a little wool, and sometimes with a little green moss on the outside; the inside is lined with fibrous roots, amongst which is usually placed some horse-hair. The eggs are four or five in number, generally of a pale reddish brown, mottled, or rather stained with a deeper colour, and sometimes sprinkled also with a few ash-coloured spots, chiefly at the larger end; but they are subject to much variation in colour. About a fortnight is required to hatch them, and both male and female perform the office of incubation by turns. The young are, even from the first, brought up chiefly on berries and fruit, whenever such food can be obtained, but, in default of this, are fed upon caterpillars, and various other insects.

The adult blackcaps are strictly fructivorous, preferring fruit of all kinds to any other sort of food whatever, and in confinement will thrive well, and sing, on this alone. Even on their first arrival in the spring they subsist chiefly on various berries, and of six, examined in the beginning of April, one only contained in its stomach the remains of insects, the others having been feeding on the berries of privet and ivy. They may nevertheless, however, be often observed examining the trees and bushes for insect food.

The blackcap is one of the hardiest of our summer visitants. Lewin shot one in Kent in January, but most probably this had passed the summer far to the north. Of three or four dozen British migrating birds that were kept in a room without a fire, two species only, this and the tree pipit (*Anthus arboreus*), survived the winter. There were four or five blackcaps, and of these not one was lost. It is in confinement a remarkably healthy species, and will do well on any sort of food that is usually given to soft-billed birds, but should not be allowed much meat. It rarely, however, becomes very familiar, unless when taken young, but often retains its wild and timid nature for years.

We may mention here a curious habit which, in confinement, is observable in several of the smaller birds, but more particularly in the fruit-eating warblers. They will occasionally be taken with a sudden and remarkable fit of activity, darting backwards and forwards about their cage, now here, now there, faster than the eye can follow, with crest and feathers of the throat erect, and uttering all the time a loud *check*, or *tchut*, which varies a little in the different species. After continuing thus for two or three minutes, they cease almost as suddenly as they began, and hop quietly about as if nothing had happened.

BLACKWELLIA (Commelin). A genus of five species of hot-house evergreen shrubs, belonging to the class and order *Dodecandria Pentagynia* of Linnæus, and to the natural order *Homalineæ*. Generic character: calyx nearly superior, in five reflexed lobes, often bearing glands; corolla, five small petals inserted on the calyx; stamens imposed on the calyx, and dilated at the base, anthers somewhat round, opening at the top; style filiform; seed vessel one-celled, with many seeds. The *B. fagifolia* is said to have fine bunches of "starry white fragrant flowers."

BLACK-WOOD is the *Melhania melanoxylon* of the *Hortus Keweusis*. It is an ornamental hot-house tree, said to be a native of St. Helena.

BLADDER KETMIA is the *Hibiscus trionum* of Linnæus. It is an ornamental annual, and is usually sown in our flower borders; being a native of Italy.

BLADDER-NUT is the *Staphylea pinnata* of Linnæus. Of this family there are three species; one of which is a tree from Jamaica, and two are shrubs, one of which, the *S. pinnata*, is found wild about Pontefract in Yorkshire. These plants belong to the fifth class and third order of the sexual system, and to the natural order *Celastrineæ*. Generic character: calyx, inferior, large, coloured; corolla, five-petalled, drooping; capsule, two or three inflated; seeds, two on each cell. The inflated seed vessel gives the name to the plants.

BLADDER SENNA is the *Colutea arborescens* of Linnæus. There are five species, natives of the south of Europe. Class and order *Diadelphia Decandria*, and natural order *Leguminosæ*. Generic character: calyx, of five teeth; two callosities at the base of the standard, keel obtuse; stigma uncinate; pod with a foot-stalk, inflated, membranaceous. Although this is not the true senna of the shops, the plants are supposed to possess qualities somewhat similar, and may be used either as laxatives or purgatives.

BLÆRIA (Linnæus). A genus of Cape of Good Hope shrubs, containing eleven species, all more or less ornamental. They belong to the class and order *Tetrandria Monogynia*, and natural order *Ericeæ*. Generic character: calyx, four-cleft; corolla, somewhat bell-shaped, and also four-cleft; stamens imposed on the receptacle, in some species protruded; anthers, two-celled, without horns, rarely with; style simple, exserted; stigma obtuse; capsule four-celled, quadrangular, angles bursting. These plants have some resemblance to heaths, and as such deserve admission into every green-house collection.

BLAKEA (Linnæus). A genus of two species of beautiful tropical shrubs, belonging to the class and order *Dodecandria Monogynia*, and to the natural order *Melastomeæ*. Generic character: calyx, membranaceous, six-angled, limb repandous, the base surrounded by an involucrum-like fringe of from four to six leaflets; corolla composed of six petals; stamens seated below the germen, anthers standing in a circle; style simple; stigma peltate; capsule a berry, invested by the calyx, six-celled; seed, angularly oval. The Blakea is one of our finest stove plants, and as it is frequently in flower, is on this account more valuable. One peculiar characteristic of the Blakeas is the regular division of the foot-stalk of the leaves, by which the face or disk is separated into a given number of spaces; hence the specific names *trinervia*, and *quinquenervia*.

BLANDFORDIA (Smith). A family of two species of herbaceous perennials, natives of New Holland. Class and order *Hexandria Monogynia*, natural order, *Hemerocallideæ*. Generic character: periantheum, simple; calyx tubular, opening into five lobes; stamens inserted in the tube; anthers, date-shaped, standing on their base; style, awl-shaped, stigma simple; capsule prism-shaped, three-parted; seeds in two rows attached to the margin of the suture; testa, lax and downy. The Blandfordias are fine showy plants, with umbels of flowers, and well worthy cultivation.

BLAPS (Fabricius). A genus of beetles, belonging to the section *Heteromera* and division *Melastoma* of Latreille, forming the type of the family *Blapsidæ* of Leach. The insects composing this family are of obscure or black colours; they are destitute of wings, and the maxillary palpi are terminated by a large hatchet-shaped joint; the body is oblong or oval. The elytra are generally soldered together, and deflexed at the sides so as to embrace the margins of the abdomen. They frequent dark, close, and damp places, as stables, cellars, wash-houses, &c., where they lay concealed during the day, under stones, in holes, &c. They are furnished with an internal apparatus for secreting a liquid of a brown colour, and of an acrid, irritating, and very disagreeable odour, which is ejected at the sides, and not from the extremity of the terminal segment of the body, to the distance of six or eight inches. The hind legs are only furnished with four tarsal articulations. The species are of a moderate or small size. The insects are nearly related to the Tenebrionidæ and Pimeliidæ both in their structure and habits; from the former they are easily distinguished by their apterous and broader-formed body, and by the conical terminal joint of the palpi, and from the latter by the character of the palpi. Although destitute of wings, nature has not given them by way of compensation, the power of running with that agility which distinguishes those ground beetles (Carabidæ), which are similarly circumstanced. This slowness of motion is, indeed, an attendant peculiarity resulting from the nature of their food, which consists, not of living insects like that of the Carabidæ, but of putrescent animal or vegetable matter.

Here then we have, amongst some of the lowest animals, an example of that adaptation of means to the end, which is more perceptible, simply from the increased facility of observation, amongst the larger animals. Carnivorous animals, or rather, animals of prey—living prey—are necessarily endowed with great celerity of motion, to enable them to obtain their necessary supplies of food, which would otherwise escape pursuit; and we accordingly find the tiger beetles, ground beetles, and others exceedingly active, even where destitute of wings but herbivorous animals, and especially such as feed upon putrescent matter, are almost universally slow in their motions. There are, indeed, exceptions to this rule, especially amongst such animals as are destitute of means of defence, but in the beetles under consideration, we observe security against the attacks of enemies in the hardness of the covering of the body, and in the fœtid odour produced by the emission of the fluid from the extremity of the body.

In Mr. Stephen's Works on British Entomology, this family comprises only the two British genera—*Misolampus* and *Blaps*. This arrangement is formed upon that of Dr. Leach, which was again taken from the first edition of the *Règne Animal;* but in the later editions of that work, the family is considerably extended, and embraces the greater part of Mr. Stephen's second section of the family *Tenebrionidæ.*

According to the last mentioned edition, which is indeed the latest authority upon the subject, the genera are thus arranged :—

1. Elytra more or less acuminate. Tarsi not dilated.

1 (*a*). Mentum small, less simple or spined.

Genera. *Blaps,* oxura, acanthomera, misolampus, gonopus.

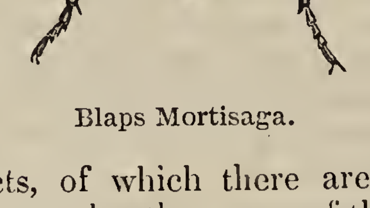
1 (*b*). Mentum very large ; thorax broadest in front, or gradually dilated at the sides.

Genus. Asida.

2. Elytra not acuminate. Tarsi of the fore legs more or less dilated in the males.

Genera. *Pedinus,* opatrinus, dendarus, *Phylan, Heliophilus,* eurynotus, isocerus, blapstinus, and platyscelis.

Of the genera recorded above, those only mentioned in italics are natives of Great Britain, misolampus being of doubtful locality as such. Recurring therefore to the first of these, blaps (Fabricius), which includes by far the largest of the British species, we find it at once distinguished, in addition to the characters given above, by the nearly square thorax, the rather broad elytra, and the great length of the third joint of the antennæ.



Blaps Mortisaga.

These insects, of which there are three British species, are known by the name of the darkling, or church-yard beetles, and it seems not improbable that the latter circumstance has occasioned their appearance to be regarded by the ignorant and superstitious as an evil omen. Linnæus informs us that this is the case in Sweden. By the ancients, these insects appear to have been regarded as a species of blatta ; indeed, Mouffet, who assiduously collected the learning of the ancients respecting insects, gives the blaps mortisaga, and the male and female cockroach, as the three species, of which the genus blatta was composed. Like the latter insects, the blaps was an object of general disgust, on account of its ill scent, yet it was recommended as an infallible nostrum when applied with cedar oil, in incurable ulcers. An Egyptian species is, however, recorded to be in great favour with the Turkish women, who eat it fried in butter, for the purpose of making them fat, and also to be applied as a remedy to alleviate pain in the ear, and to cure the sting of the scorpions. For the former purpose it also appears to have been applied even in England, in the days of Mouffet. It is also recorded by Mr. Baker, the celebrated microscopic observer, respecting the blaps mortisaga, that he kept a specimen alive under a glass upwards of three years without food (Phil. Trans. 1740). The faculty of sustaining a long abstinence from all kinds of food, of which numerous examples might be cited, is regarded by Messrs. Kirby and Spence, as dependant in some degree upon the nature of their food ; vegetable feeders requiring a constant supply, whilst those which are predaceous and exposed to the danger of being long without food, are often endowed with the powers of fasting to a remarkable degree. This argument is not, however, applicable to the case of the darkling beetle, which, indeed, seems to be much more easily accounted for upon the principles which in another part of this celebrated work these authors have mentioned, namely, that if by any circumstance the union of insects is deferred beyond the ordinary period, their lives may be protracted far beyond the usual term, and hence that the great age to which Mr. Baker's blaps attained, was owing to its being a virgin when taken, and subsequently kept from any sexual intercourse. A parallel case is stated by these authors too amongst vegetables, where an annual plant, if kept from seeding, will become biennial, as likewise if they are sown too late in the year to produce seeds. But it is not alone in its powers of abstinence that its tenacity of life was observed, for the same insect had previously revived after being immersed in spirits of wine a whole night*. This circumstance may perhaps enable us in some degree to account for an extraordinary case reported in the Dublin Medical Transactions of 1824—1828, by Dr. Pickells, of Cork, and which, from the number and competency of the observers, there appears not to be the slightest reason to doubt. For several years, a middle-aged female continued to throw up incredible numbers of grubs, chiefly of the blaps mortisaga and maggots of a dipterous insect. "Of the larvæ of the beetle," says Dr. Pickells, quoted in Insect Transformations, "I am sure I considerably underrate when I say, that not less than seven hundred have been thrown up from the stomach at different times since the commencement of my attendance. A great proportion were destroyed by herself to avoid publicity, many too escaped immediately by running into holes in the floor. Upwards of ninety were submitted to Dr. Thomson's examination, nearly all of which, including two of the specimens of the meal worm (tenebrio molitor) I saw myself thrown up at different times." It appears that this female had some time previously, in the performance of a strange superstition, been in the daily habit

* A similar circumstance, which occurred with a lady-bird (coccinella), fortunately for Entomologists, induced Mr. Kirby to turn his attention to insects, and Mr. Curtis has observed the same fact after an immersion of twenty-four hours. It is to be observed, that in both instances the insects possess the power of secreting a very acrid liquid.

of drinking a quantity of water mixed with clay, taken from the graves of two Catholic priests, to purchase eternal immunity from disease and sin; and that upon one occasion she had lain upon her mother's grave during a night, and had been exposed to heavy rain. Now, as we cannot agree with the former of the suggestions of Mouffet, respecting this very insect, "An vero hæc ex putri materia oriatur, vel mutua commistione maris et fœminæ generetur, ignoramus," although the development of intestinal worms has always been one of the strongholds of the sticklers for the doctrine of equivocal generation—we must conclude that the grubs voided by the above-mentioned woman were produced from eggs which it is most probable were introduced into the stomach with the clay water which she drank, and the occasional length of time taken for the hatching of insects' eggs, or the duration of the larva state in beetles for several years, may account for the continued discharge of larvæ. It is also to be observed, that one pupa and one perfect insect alone were voided; and from the figure given of these of the natural size and magnified, the insect does not appear to be the species above named, being much too small and narrow.

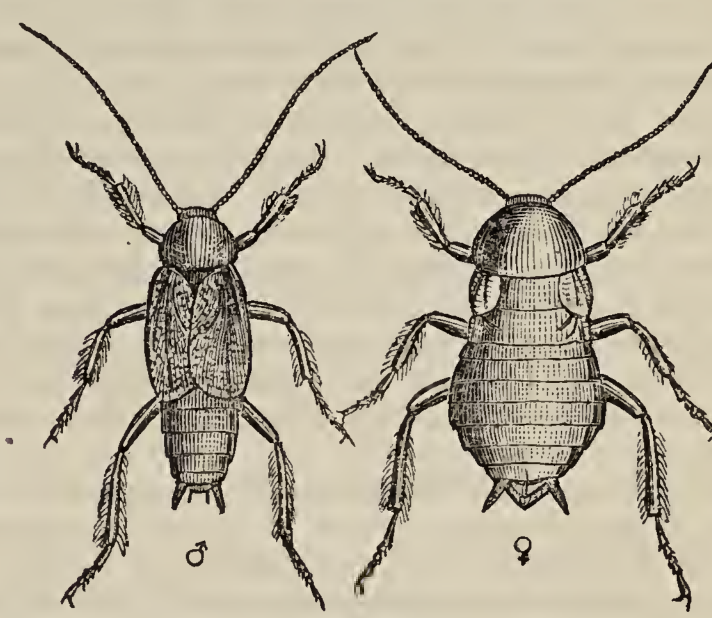
Of the other genera, composing the first section of the family, nothing appears known of their habits. The species of *Asida* frequent sandy districts, whilst *Pedinus* and the genera of the second section are chiefly found upon the sea coast.

BLATTA (Linnæus). The Cock-roach. A genus of orthopterous insects, forming the type of the family *Blattidæ* of Stephens, and belonging to the section *Cursoria* of Latreille. As a group they are distinguished by the tarsi furnished with five joints, the under wings folded longitudinally only, and not transversely as in the earwigs, the head concealed by the anterior margin of the thorax, the body oval or rounded and generally flattened, and the fore legs formed only for running, and not for prehension as in the mantidæ; the elytra are leathery, nervose, and lapping over each other at the inner edge. These characters induced Dr. Leach to raise these insects to the rank of a distinct order named *Dictyoptera*, but the distinguishing features of the group are far too slight to warrant its establishment, and entomologists have therefore not adopted this mode of arrangement. The antennæ are very long and thread-like, consisting of an immense number of minute articulations. The mouth is furnished with a pair of powerful jaws, under jaws, &c., and the palpi are long. The thorax has somewhat the appearance of a shield, the elytra are generally as long as the body, the extremity of the abdomen is furnished with a pair of minute conical articulated appendages. The legs are long and armed with minute spines.

These insects are of moderate size, but some species acquire the length of an inch and a half or two inches. They are nocturnal in their habits, extremely active, and the majority reside in the interior of houses, where they delight to take up their abode in the neighbourhood of fire-places in kitchens, &c., but especially in bake-houses, and other situations where much cooking takes place, where they inhabit the clefts of walls near ovens by day, coming forth by night in myriads, but retreating with the utmost precipitation to their holes immediately that a candle is intruded amongst them. They are extremely voracious, destroying almost all sorts of provisions, but more particularly bread and other vegetable matters. It is very difficult to extirpate these disgusting insects, which, in addition to the destruction which they cause, emit an exceedingly disagreeable odour, which attaches to whatever they have crept over. Perhaps the most advantageous method of destroying them is to use a small wooden box with sloping sides, having a circular aperture at the top with glass edges, out of which it is impossible for them to escape. This should be nightly baited, and the contents thrown the following morning into scalding water. This plan is certainly superior to the employment of red poisoned wafers.

These animals were known to the ancients, who named them *insecta lucifuga*, on account of their shunning the light. The insects which they termed *blattæ* were certainly distinct, although it is not easy to decide as to what they really were.

The species which are truly indigenous in England are of comparatively small size, and are generally found in woods; but the species which frequent our houses, occasionally in such myriads as to cover the floors of the lower apartments in the metropolis at night, are of more southern origin, the ordinary species (*B. Orientalis*) being a native of Asia. It is



Blatta Orientales (Male and Female).

probable that its introduction was owing to the navigation of the Levant, being brought over in ships' cargoes. They generally swarm on board ship; and it is evident that such was also the case in the time of the ancients, from the following passage from Mouffet:—" In Philippo navi quam nobilissimus ille Neptunus (Dracum equitem intelligo) aromatibus onustam vi cepit, ingens blattarum alatarum multitudo inveniebatur." At the present day we have heard that the boys on board old ships have been employed at leisure times in catching and stringing these insects, receiving a trifling reward for every score caught. It is to the same cause that the American cockroach (*B. Americana*), a much larger species than the ordinary one, is gradually acquiring a settlement in London and other ports. But the ravages of these insects in warm climates appear to be far greater than amongst us, from the following account given by Drury of the *B. gigantea*, which he had himself observed:—" The cockroaches are a race of pestiferous beings, equally noisome and mishievous to natives and strangers, but particularly to collectors. These nasty and voracious insects fly out in the evenings and commit monstrous depredations; they plunder and erode all kinds of victuals, dressed and undressed, and damage all sorts of clothing, especially those which are touched with powder, pomatum, and similar substances; every thing made of leather, books, paper, and various other articles, which if they do not destroy, at least they soil, as they frequently deposit a drop of their excrement where they settle, and some way or other, by that means, damage what they cannot devour. They fly into the flame of candles, and sometimes into the dishes, are very fond of ink and oil, into which they are apt to fall and perish. In this case they soon turn most offensively putrid, so that a man might as well sit over the cadaverons body of a large animal as write with the ink in which they have died. They often fly into persons' faces and bosoms, and their legs being armed with sharp spines, the pricking excites a sudden horror not easily described. In old houses they swarm by myriads, making every part filthy beyond description wherever they harbour, which in the day-time is in dark corners, behind all sorts of clothes, in trunks, boxes, and, in short, in every place where they can be concealed. In old timber and deal houses, when the family is retired at night to sleep, this insect, among other disagreeable properties, has the power of making a noise, which very much resembles a pretty smart knocking with the knuckle on the wainscotting. The *B. gigantea* of Linnæus in the West Indies is therefore frequently known by the name of the drummer. Three or four of these noisy creatures will sometimes be impelled to answer one another, and cause such a drumming noise that none but those who are very good sleepers can rest for them. What is most disagreeable, those who have not gauze curtains are sometimes attacked by them in their sleep; the sick and dying have their extremities attacked; and the ends of the toes and fingers of the dead are frequently stripped both of the skin and flesh."—Drury, Illust. Nat. Hist. vol. iii. Preface.

A small species of Blatta, the *B. Lapponica* of Linnæus, is stated by that author to swarm in the huts of the Laplanders, and occasionally to devour, in conjunction with the *Silpha Lapponica*, the whole supply of dried fish in a single day. The species thus named by English entomologists is found in woods, and, from the difference in its habits, it may reasonably be supposed to be a different species.

But the most singular circumstance connected with these insects consists in the manner in which the eggs are deposited. Instead of these being laid singly, as is generally the case amongst insects, nature has given the females a most curious instinct for the preservation of their offspring. In fact, the females deposit a large oblong mass, convex at the sides, and flattened at the edges, which serves as a case for an entire family of young blattæ. This mass, which is of large size, being nearly half the entire size of the

abdomen of the female, is borne about by her for a considerable period. At first it is white, but gradually becomes dark brown. Although composed of a single piece, the edge along one side is slit, the margins of each side of the slit being denticulated and fitting into each other, and being cemented together so strongly that the other portions are even less strong than at the union of the sutures. Nature has however provided the enclosed insects with a key to this prison, enabling them to escape at the fitting period; this consists of a fluid which they emit, and which softens the cement of the denticulated margins, and affording to the young captives the means of escape from a situation in which they had previously attained a sufficiency of strength to enable them to follow their habits. On their quitting the case the cleft shuts again so accurately that it appears as entire as before. On opening this cocoon, as it may be called, it is found to contain about sixteen eggs of an oblong oval form, arranged in a double series, in which the young are brought to a considerable state of maturity. This singular proceeding occupies the female about a week, and suggests several interesting points of inquiry as to the manner in which the eggs are arranged by the female, the nature of the envelope, the cause of its being so long borne about by the parent, &c. It has indeed been said, that so careful is the female of her egg pouch, that she covers it upon quitting it with the materials of the substance upon which she places it, so that neither man nor any prying mouse or other animal can detect it; but it would seem that this assertion has been made by confounding the blattæ with the tineæ, since the former, as we have noticed, simply deposits her case of eggs in some secure situation. The larvæ and pupæ are equally active with the imago, and not less destructive, differing only in their smaller size and in entirely wanting or having but the rudiments of wings and elytra.

There are about a dozen indigenous British species of this genus, all of which are rare; but the number of exotic species is very great, and they are but little known, scarcely any entomologist having paid attention to the group, which notwithstanding contains some very curious forms. Latreille has divided the family into two genera, *Blatta* and *Kakerlac* (the name by which the blattæ are distinguished by the American colonists), giving the *B. orientales* as the type of the latter, which differs from the former in the females being destitute of wings. As, however, the *orientales* is the type of the Linnæan genus blatta, we have distinguished the *B. Lapponica*, and other British species composing the Latreillan genus blatta, under the name of ectobius, and which have tegmina and wings in both sexes. The other genera are *Blaberus*, *Panesthia*, *Pseudernops*, *Corydia*, *Phoraspis*, and *Perisphera*, all recently established by M. Serville in the Annales des Sciences Naturelles, upon various exotic species.

BLEABERRY is the *Vaccinium uliginosum* of Linnæus; a British plant found on wild moorland places. The berries are eatable, but of inferior quality.

BLECHNUM (Linnæus). A genus of exotic ferns, consisting of ten species; divided into two sections, viz. with fronds pinnated, leaves entire; and fronds pinnate, leaves serrulated or denticulated. They require a hot or green-house.

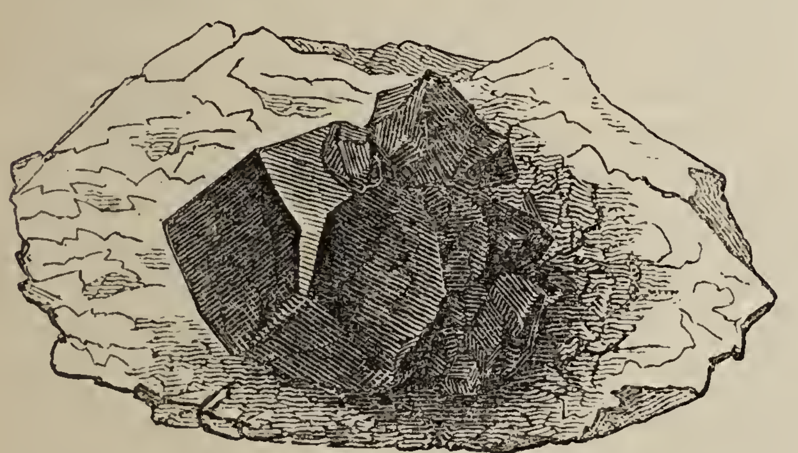
BLECHUM (Jussieu). A family of four species, hot-house perennial herbs, introduced from the West Indies. Class and order *Didynamia Angiosperma*, and natural order *Acanthaceæ*. Generic character: calyx, five-parted, persisting; corolla, funnel-shaped, the limb five-cleft; stamens, two-celled; style filiform, stigma cloven; capsule one-celled, two-valved. The Blechums rank among ornamental plants; but not conspicuously beautiful.

BLENDE. This mineral varies considerably in its external appearance and other general characteristics. The zinc-blende, so well known in our lead mines, is called by Mohs "garnet-blende," merely from its resemblance to that mineral. The yellow zinc-blende occurs along with galena or lead-glance, copper-pyrites, red cobalt, and heavy-spar, in veins that traverse quartz-rock, at Clifton Mine, near Tyndrum in Perthshire; also in Flintshire.

Very beautiful specimens are met with in Bohemia, where it is associated with galena, grey copper, iron-pyrites, brown-spar, and quartz; and sometimes also with native silver, silver-glance, or red silver. It is also found at Scharfenberg in Saxony; Rammelsberg in the Hartz, in veins in transition rocks. The green varieties are found at Gumerud in Norway, associated with galena, and smalt-blue apatite, in transition rocks; and it is accompanied by red manganese, at Nagyag in Transylvania. The foliated brown zinc-blende usually occurs massive and disseminated; also in granular distinct concretions, varying considerably in magnitude. It is found in Scotland; in the lead mines in England; and in various other parts of the world.

Black zinc-blende is principally valued on account of the zinc which it affords. In order to obtain that metal from it, it is first roasted, to drive off the sulphur, and then ground with charcoal, and exposed to heat in a crucible, when the metal is reduced, and sublimes into a lute, so placed as to convey it into water, where it condenses in small drops. By our English miners, blende is named "black jack."

A specimen of blende in the collection of minerals at the British Museum is represented in the accompanying engraving.



The prismatic antimony blende is a rare mineral, and is considered as an ore of silver in the districts where it occurs. For an account of the rhomboidal ruby blende see SILVER.

BLENNY (*Blennius*). A genus of *Acanthopterygeous*, or spinous-finned fishes, belonging to Cuvier's family of *Gobioidæ*, or the gudgeons. The genus has received the name blenny from the mucous matter with which the skins are covered; βλεννα being the Greek for mucus.

All the species, which are rather numerous, have a very easily distinguishing character in the ventral fins, which are placed before the pectorals, and have only two rays in each. Their bodies are long and compressed. They have, strictly speaking, only one dorsal fin, but that is sometimes divided into two lobes, which to partial observation gives it the appearance of two distinct and separate fins. The rays of the dorsal are all entire, or without articulation, but they are soft and flexible. The stomach is small, and the intestine short and without any cæca. They are also destitute of an air bladder. Many of them are viviparous, or bring forth their young alive. They are found in small shoals, among rocks or near the shores; and they are very lively fishes, leaping, swimming, and sometimes getting out of the water, where they have the power of living longer than many fishes, probably on account of the mucous secretion with which they are covered. They are in general small fishes, and of little or no use to man in an economical point of view.

Lacepede includes twenty-three species in the genus, which he divides into four sections or subgenera, according to the characters of the head and the dorsal fin. The first of these have two lobes in the dorsal, and filamentous appendages to the head; the second have only one lobe and the filaments; the third have two lobes in the dorsal, but no appendages to the head; and the fourth have one lobe, and no appendages. It does not, however, appear that any particular difference of habit can be indicated by these characters, as we are in a great measure ignorant of the uses of the filaments attached to the heads of fishes, and also to the difference of action arising from the dorsal fin being single in double. Cuvier takes a different method, including about eight or nine species as true blennies, and ranging the others into different genera according to their characters.

The true blennies have the teeth long, closely set, forming only one row in each jaw, and terminated in front, in some of the species, by a recurved tooth longer than the rest. They have the head obtuse, the muzzle short, and the line of the forehead nearly vertical. Their intestinal canal is short and wide. The greater number have a fleshy or cartilaginous appendage over each eye, which is divided into different branches; and some of them have a similar one on each temple. The following are some of the species.

Blennius ocellaris (the eye-spot blenny, or "butterfly fish"). This is a small species, seldom exceeding four inches in length. It is brown with a greenish tinge, and spotted. The dorsal fin is formed into two lobes, the first the highest, and the first spine of it the largest. It is upon this fin that the spot from which it gets its name is situated. The centre of the spot is a circular line of black with a purplish tinge, surrounded by a circle of white, and then outside with another of the same colour as the central disc. The eyes are elevated nearly to the same height as the line at the top of the head; the irides of them have a silvery lustre; and the appendages over them are fringed on their posterior margins.

This is rather a rare species in the British seas; and when it is met with it appears to be brought by the current from the warm shores of Europe, as it has been met with only or chiefly on the south coast of England, and the shores of the Irish Channel. It is, however, much more abundant in the Mediterranean. It is always found near the shores, or otherwise in shallow water among stones and marine plants; and it sometimes, in that sea, attains the length of six or seven inches; but its flesh is tasteless, and it is not sought after by the fishermen. The surface of its body abounds in the viscid or mucous matter from which the genus is named.

Blennius tentacularis. This species is rather longer than the former. The head is compressed and blunt, the eyes stand higher than the line of the crown;

and they have the irides reddish orange. There are four filaments over the eyes, forming a double crest fringed on both sides. The dorsal fin has only one lobe, and the first ray is short. The jaws are of equal length, and each furnished with an even row of teeth. There is a very characteristic spot, of a black colour, extending across the fourth and fifth rays of the dorsal fin. This species is found both in the Mediterranean and the Atlantic; but it is very rare as a British fish, and found only on the southern shores.

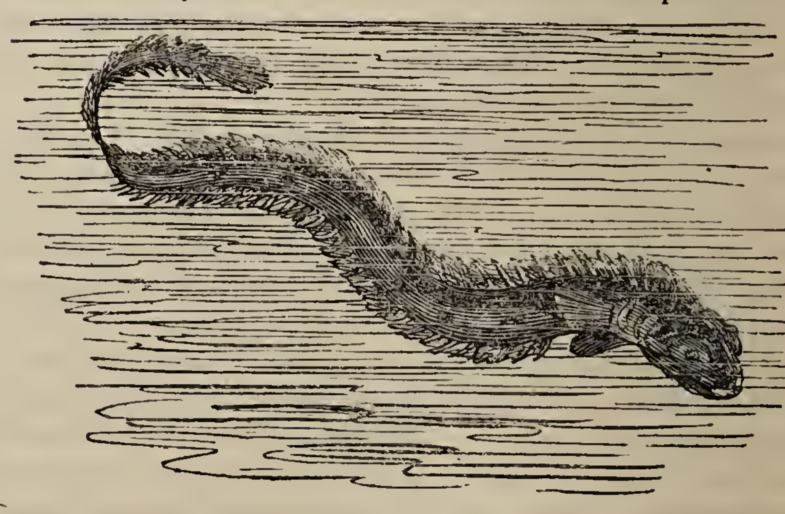
Blennius gattorugine. This species has only two filaments over the eyes, and one lobe in the dorsal fin. The body is reddish, the fins marked by oblique bands of brown; the eyes elevated above the line of the crown, and with orange irides. This species is also very rare as a British fish, and found only on the south and south-west coasts. It reaches to about seven inches in length.

Blennius palmicornis, has the appendage over the eye divided into smaller filaments for the greater part of its length, and only one dorsal fin. The head is small, the eyes projecting, with the irides reddish, and near the crown of the head. The jaws, of equal length, covered with an even row of teeth each. This species also inhabits the Mediterranean and the Atlantic. Its flesh is said to be better than that of most of the genus; but it has been occasionally confounded with the species immediately preceding.

The remaining species of the genus have not the produced filaments over the eyes so prominent as those which have been enumerated; but they have a sort of membranous enlargement on the crown; and it is somewhat curious that this appendage to the heads of these fishes, enlarges and puts on a bloom of colour in the pairing season, in the same manner as those on the heads of various species of birds. There is a farther analogy, though it is but faintly shadowed out by the observations which have yet been made; for "the laws of the fishes," are an obscure, though far from an uninteresting part of natural history. The birds which have this seasonal bloom in the fleshy appendages of the head, and not merely in the brighter tints of nuptial feathers, are generally, though not all, polygamous; and *there is some reason to believe* that the viviparous, or rather that the ovoviparous blennius, in which this seasonal enlargement and bloom of the crest are most conspicuous, are also polygamous. On the other hand, birds which bloom only in the feathers, and fishes which bloom in the fins, or the spots on the skin, as is the case with most of the spawning fishes, are chiefly monogamous. Thus there seems to be in two classes of vertebrated animals, which are very unlike each other in their forms, their haunts, and their habits, some similarity in the part of the body, on which the external sign of the most important of their physiological actions makes its appearance. But the subject has been so little studied in the case of fishes, that inferences from it are by no means safe.

Blennius galerita (crested or helmeted blenny). This species has only one lobe in the dorsal fin; it is spotted and rayed with blue, and has a black eye-shaped spot behind the eye. The appendage from which it gets the appellation of crested, is an elevated duplicature of the skin which crosses the top of the head, and to which it can communicate some motion. It is found in the Atlantic and Mediterranean, and is supposed to be rather more dispersed northward than some of the others. It is about seven inches in length, and a very active little fish, frequenting the rocks and shores, but very difficult to be caught with the hand, in consequence of the slipperiness of its body from the mucous secretion. The ground colour on the upper part is usually brown, and that on the under part bright green and black; but the colours are understood to vary in different individuals, and in the same at different ages and different seasons. It is not improbable that these differences have caused it to be multiplied into several species; and the same has probably been the case with some of the others. This one is very tenacious of life after it is out of the water, which is accounted for by the smallness of the gill openings, and the mucous covering of the skin. We have elsewhere had occasion to remark (in the article Anabas) that as long as the gills of a fish can be kept so moist that all their filaments are covered with a coating of water, the fish will, unless for the drying of the surface of its body, live and breathe out of the water. This is a proof of what was said in the article Air, about the impossibility of fishes decomposing water so as to obtain the oxygen out of *its composition.* They merely breathe the air which is contained in the water in a state of mechanical mixture; and thus if there is a complete coating of water through which the air must come to the breathing apparatus, it matters less whether that coating be the fiftieth part of an inch or fifty feet, so that it is entire over the whole apparatus, and no air can reach that but through the aqueous coating. Those surface fishes which pant and die almost the instant that they are exposed to the air, always have the gill openings large and free, and of course the air speedily so dries the gills that they are unfit for performing their function. We shall notice only one other species.

Blennius pholis (common blenny, viviparous blenny, or viviparous gunnell of some authors). This species has no appendages to the head, and the crest is little elevated, though it is subject to the seasonal bloom of colour already alluded to. This species has the gape wide; the upper jaw advanced a little in front of the under one. The teeth pointed, strong, and closely set. The opening of the nostrils is in a sort of tube; the facial line very vertical; the eyes large and prominent; and the irides of a reddish colour. The cavity of the belly is very short. The dorsal fin has only one lobe; but there is a depression in



Blenny.

the middle. The general colour is olive brown marbled with paler spots and black, some of which are very minute; the under part is yellowish. It attains the length of twelve or fifteen inches.

This species is common upon most parts of the

British shores; and is known by various local names, such as the "guffer," the "eel-trout," and the "green bone," the last from the circumstance of the back bone becoming green when the fish is boiled. It is also called the "stone perch," though it has none of the characters of the perch family.

During great part of the year it lurks under stones in the shallows, and especially near the estuaries of rivers; and it is supposed sometimes not to retire with the tide, but to conceal itself under stones till the water return. When thus in the shallows, it is very frequently seen, and not very difficult to approach; but if caught, it glides through the fingers with more facility than even the eel, and it is on this account that it is called the eel-trout. In summer, about the time when the wild cruciferæ come into bloom in the corn-fields, it takes to the water and becomes a swimmer; but remains in the bays and estuaries as a surface swimmer. It is there readily caught with a baited hook, so much so that it is often an annoyance to those who fish on the grounds which it frequents in the hope of meeting with something better; as it takes the bait so much more readily than those, that it spoils the sport of the summer fisher in those safe and quiet places. When caught it is of little or no use, as its flesh is meagre and tasteless. It is ovoviviparous; and the fact of its being so has been long known.

The blennies appear a very useless genus; but they are curious in their forms, and they hold a particular place among the finny tribes. They are, strictly speaking, shore fishes: yet from the fact of some of them appearing only occasionally upon our shores, it is probable that they are, at some seasons much more discursive than is generally supposed, for at the places where the stragglers are found, there are more in the same settled habitations among the sea weed and stones, as they resort to where they are known to be resident.

Of the nearly allied species, many of which have been described as blennies, though they differ from them in their leading characters, some more, some less, there are some which are found in the British seas, and others only in the southern parts of the world. Of these some grow to the length of two or three feet; but even these are of little value in an economical point of view. See Myxodes, Salarias, Clinos, Cirrhibarbus, Murœnoides, Ophistognathus, and Zoarcis for the particulars.

BLEPHARIS. A genus of spinous-finned fishes, belonging to the mackerel tribe, and to the family or sub-division of that tribe, to which Cuvier has given the name of *Vomer*. The whole of the spinous-finned fishes are very difficult of arrangement, as the form and position of the fins, the usual grounds of arrangement in fishes, cannot be so readily applied to them as to the soft-finned ones. The mackerel family are all surface-fishes, rapid swimmers, voracious feeders, altogether very active in their motions, their flesh in general wholesome and agreeable to the taste, but in some of the species rather dry. See Scomberoidæ.

Linnæus and Bloch included the whole of the division *Vomer* in the genus *Zeus* (the dory), but Cuvier has separated it, and formed the very various fishes of which it is composed, into six sub-genera, of which *Blepharis* is one. The bodies of all these fishes are remarkably compressed; so much so, that though, when seen from above or below, they do not appear thicker in proportion to the length, than fishes of more ordinary form, they appear very deep when viewed on the side.

It is worthy of notice that while many of the fishes which remain near the bottom in the shallows or on the banks, have the body so much depressed or flattened, that they get the common name of flat fish; many of those which inhabit near the surface have the enlargement in depth, and the compression laterally. The flat ground fishes are all soft-finned, and have the fins often margining nearly the whole body, and the skin and fins containing a great quantity of gelatine; but they are, in general, not much produced, and no portions of them project far beyond the rest. In these flat fishes, though the body is depressed as regards the position in which it is usually carried, it is really compressed; and the lines on which the fins appear, are not the lateral lines of the fish, but the dorsal and ventral lines, in the same manner as those to which the fins of fishes which are not flat, and all the laterally compressed ones, such as the genus under consideration, are attached.

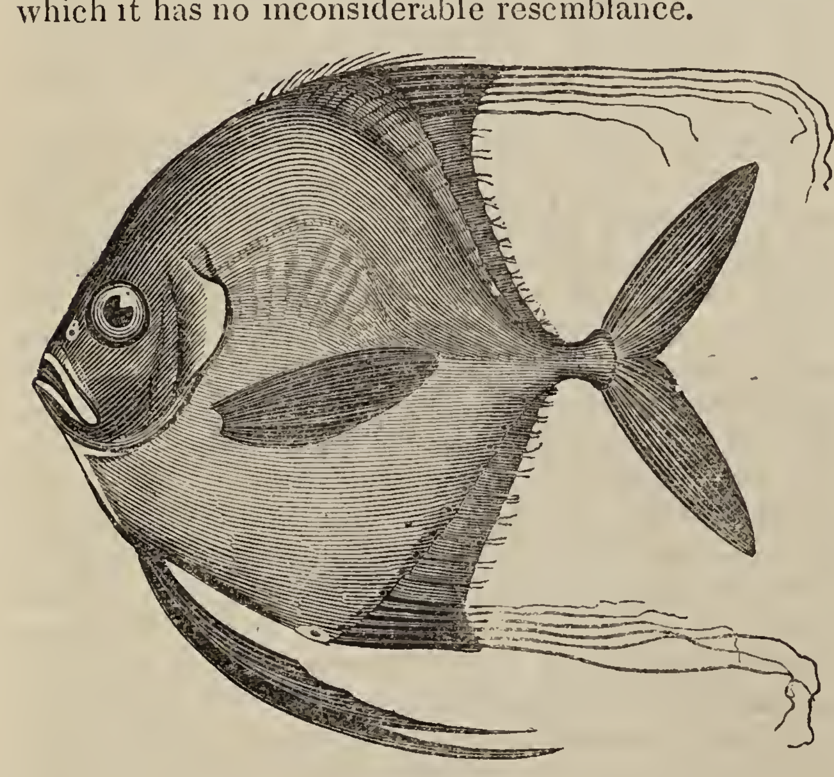
Thus, the flat fish and the compressed fish are both flattened in the same way with reference to the posterior portion of the spine and the way in which the muscles act in giving motion to the body,—only the flat fish carries itself with the greater portion of the body borne with the side under, while the compressed fish has the belly in that direction. A twist of the head brings the eyes to one side of the body, and gives an oblique position to the mouth, so that, in looking to a sole, a flounder, or a turbot, a line passing through the eyes will be seen to be parallel to the mesial plane of the body, or the plane passing through the ridge of the back and the centre of the belly, and not at right angles to that bone, as in other fishes, and indeed almost every other animal.

This is not the proper place for inquiry into the purpose which this very peculiar form of the body answers in the economy of these animals (see Flat-Fishes); but still there is so much both of resemblance and of contrast between those fishes which have the body compressed, and swim with it on the flat, and those which swim with it on the edge, that much information respecting their habits might be drawn from it. Indeed, there is reason to suppose that, if this were properly studied, it might explain the different uses of the several kinds of fins and of scales to fishes in the operation of swimming.

Both descriptions of animals, though they belong to very different parts of the system, according to the characters upon which it is at present founded, have yet some very striking coincidences. Both are smooth fishes, either with no perceptible scales, or with the scales so very small that they are of comparatively little use in swimming; in both, the flesh is wholesome and agreeable; and both, from the smallness of the scales, have to depend wholly on the fins and the flexures of the body as the means of progressive motion. But the fins of the flat fishes are small and soft, and the chief action of the body is in the vertical direction, or that which acts more powerfully in ascent and descent than in progressive motion. The fins of the compressed fishes which swim with the body on edge, are, on the other hand, produced, and have strong spinous rays, while most of the division *vomer*, and the genus *blepharis* in an especial manner, have filaments attached to some of the fins. Farther, the flat fishes have the colour and texture which answer to those of the back in ordinary fishes, extending over one side of the body, from the dorsal line to the vertical, and the colour and texture which answer to those of the belly extending over the other side, without any very strongly-marked lateral line at the turn of the muscular plates in either. Although these two surfaces are in reality, and with reference to the spine and the muscles, the two lateral sides of the fish, yet in their covering they have thus the appearance of being, all along, the one the back and the other the belly. In the compressed ones which swim on the edge, as blepharis does, the colours of the upper and under parts, the back and belly, answer to those of ordinary fishes. The lateral line is, in many species, distinct, and in some it has a remarkable curvature upward, at the place where the cavity of the fish is situated. It should seem, therefore, that the coverings of the upper and under sides of fishes have reference to the position in which they are carried, and not to the parts of the fish upon which they are placed; while the way in which the largest diameter of the section is placed has reference to the place which the fish holds in the water, and the style of swimming.

The compressed fishes which swim on edge, all inhabit near the surface, and they are rapid swimmers, and rather discursive in their motions; whereas those which swim on the flat of the body keep nearer the bottom, swim slowly, and do not range far. The fish which swims on edge, has the tail much more effectively formed as a swimming organ, and the fins much more firm as well as much more produced. The filaments which are attached to the fins also appear to be of use in steadying the fish, and preventing it from swinging or turning on the flat as it swims, which it would have a tendency to do, if it had not these appendages to steady it.

There is but one species of *blepharis* (the name of which by the way is the Greek for filaments, *ciliæ*, the hairs of the eyelids). It is found in the tropical seas only, and principally, we believe, in the neighbourhood of the West Indian Islands, in some of which it is called "the shoe maker," or the "cobler-fish," in allusion probably to the thread-like appendages to the fins. It is the *Zeus ciliaris* of Bloch, but it has probably been confounded with some oriental species to which it has no inconsiderable resemblance.



Blepharis.

The external characters, as may be seen from the figure, are: the body much compressed and elevated; the profile in nearly the ordinary position, the muzzle not so protractile as in the dorey, the ventral fins very large, the anal and second dorsal with very long filaments, and the spines of the first dorsal short. The large ventral fins no doubt co-operate with the filaments of the anal and the dorsal in enabling them to preserve the position of their short and thin bodies. They, and indeed the whole of the division to which they belong, are very curious fishes.

BLESSED THISTLE is the *Centaurea benedicta* of Linnæus. An ornamental annual, indigenous to Spain, and belonging to the natural order *Compositæ.*

BLETHISA (Bonelli). A genus of coleopterous insects belonging to the section *Pentamera Adephaga*, family *Carabidæ*, and sub-family *Elaphridæ*, and nearly allied on the one hand to *Elaphrus*, from which the species are distinguished by the somewhat square thorax, and by the elytra being deeply excavated, and on the other hand to the *Pelophila* of Dejean (of which genus an individual has occurred in Ireland), from which it is separated by its slightly dilated anterior tarsi in the males. The species of this genus are few in number, Dejean only recording three, all of which are natives of the North of Europe: one only has, however, occurred in England, the *Carabus multipunctatus* of Linnæus, and which is found in damp situations running upon the mud of ponds. It is a handsome species, about half an inch long, of a fine brassy colour, with a brighter margin, and the elytra have four rows of deep impressions.

BLETIA (Ruiz and Pavon). A family of herbaceous, tuberous rooted perennials, natives of China, West Indies, &c. Class and order *Gynandria Monandria*, and natural order *Orchideæ*. Generic character: sepals of calyx, spreading, nearly equal; labellum open, cupped, or a little tubular, clasping the base of the column, or spurred, apex dilated, somewhat lobed and undulating; column cylindrical, curved and channeled before, apex obtuse, anthers terminal, covered with a lid. There are nine species of Bletia, all handsome, some of them splendid. The *B. Tankervilliæ* was the *Limodorum Tankervilliæ* of the *Hortus Kewensis*, and has had various other names by different botanists; it is certainly one of the finest of the Orchideæ.

BLIGHIA (Hortus Kewensis). A single African tree, named in honour of Captain Bligh, who first carried the bread-fruit to the West Indies. Class and order *Octandria Monogynia*, and in the natural order *Sapindaceæ*. Generic character: calyx five-parted; petals furnished with vaulted scales at the base; disk fleshy, crenated, bearing the stamens; filaments thickest in the middle; anthers twinned, two-celled; style scarcely any, stigma simple; fruit fleshy, six-lobed, three-celled, three-valved, one seed in each cell. This is called the Akee tree in the West Indies; the arillus of the fruit being richly palatable.

BLIGHT. A term of very common occurrence, implying the sudden appearance of great numbers of minute grubs, especially upon fruit trees in the spring, attributed by persons who have not investigated the nature of insects, and their various transformations, to the operations of particular winds; thus, of an easterly wind, we often hear it said that it is a blight, or that there is blight in the air. In like manner, the plant-lice upon rose trees and other plants, are termed blight. Now, if it be granted that the wind has any thing at all to do with the matter, one of three things must occur: either the blight must be spontaneously generated by the action of certain currents of air, or the eggs from which the various blights or grubs are produced must be floating about in the air, or, lastly, the prevalence of certain winds must have an influence in giving birth to animals enclosed in eggs deposited by parent insects upon the spot upon which the blight is seen. As the first of these propositions depends entirely upon the doctrine of equivocal generation, a doctrine which is exploded by every naturalist (except such as endeavour to supply from their own prejudiced imaginations those points in the economy of nature which the minuteness of the objects or the difficulty of their investigation have rendered it next to impossible to prove by actual examination), we shall enter into no attempts to refute it, merely observing that in every instance amongst insects where an attentive observation has been made upon the nature of their production, it has been found that the birth of every individual has been the result of the impregnation of the female and the subsequent development of eggs, which are either hatched after deposition, or within the body of the parent. The second proposition, however, that the eggs are carried about in the air, merits more particular observation, as it depends upon a theory adopted by many distinguished writers. Thus, Dr. Good observes, " That the atmosphere is freighted with myriads of insect eggs that elude our senses, and that such eggs, when they meet with a proper bed, are hatched into a perfect form, is clear to any one who has attended to the rapid and wonderful effects of what in common language is called a blight upon plantations and gardens," —and in like manner the eloquent Chalmers, discoursing upon the boundlessness of the creation, observes, " About the time of the invention of the telescope another instrument was formed, which laid open a scene no less wonderful, and rewarded the inquisitive spirit of man. This was the microscope. The one led me to see a system in every star, the other leads me to see a world in every atom; the one taught me that this mighty globe, with the whole burden of its people and its countries, is but a grain of sand on the high field of immensity, the other teaches me that every grain of sand may harbour within it the tribes and the families of a busy population. The one told me of the insignificance of the world I tread upon, the other redeems it from all its insignificance, for it tells me that in the leaves of every forest, and in the flowers of every garden, and in the waters of every rivulet, there are worlds teeming with life, and numberless as are the glories of the firmament. The one has suggested to me that beyond and above all that is visible to man, there may be fields of creation which sweep immensity along and carry the impress of the Almighty's hand to the remotest scenes of the universe, the other suggests to me that within and beneath all that minuteness which the aided eye of man has been able to explore, there may be a region of invisibles, and that could we draw aside the mysterious curtain which shrouds it from our senses, we might see a theatre of as many wonders as astronomy has unfolded—a universe within the compass of a point so small, as to elude all the powers of the microscope, but where the wonder-working God finds room for the exercise of all his attributes, where he can raise another mechanism of worlds, and fill and animate them all with the evidence of his glory." This is a beautiful view of the subject, and far be it from us to lessen its effects, by limiting any of those fine ideas to which it will naturally give rise. Still we are compelled, to a certain extent, to narrow its acceptation. That the microscope discovers an infinity of animalcules, far too small for our unaided sight, is not to be doubted; and that numberless others, which the microscope cannot reach, exist, is perhaps equally certain; but it is in *fluid* matters that the most minute of these creatures are found. If they floated in the air, or if they pervaded all substances, it cannot be doubted that the field of a high-powered microscope would necessarily discover some of the larger of them wafted about within its focus, when " nothing but emptiness" was placed within its power. But this is not the case; an observer may watch all day, and he will not see any aerial monster, invisible to human unassisted sight, pass across his field of view; but let him place the smallest drop of fluid in the focus of his microscope, and it will be found to swarm with life, so as fully to warrant all the eloquence which Dr. Chalmers has used upon the subject. In this point of view, therefore, the question assumes a high degree of importance, as connected with a circumstance which has been repeatedly noticed in various works relative to that dreadful scourge which unfortunately appears to have taken up its abode with us—we allude to the cholera morbus. By some writers this pestilence has been considered as attributable to swarms of insects. Thus it is recorded, as a curious fact, that its arrival at Moscow was preceded by a cloud of little green flies, which darkened the air, and covered persons from head to foot when they entered the streets, which flies, by some medical men (see Neale on Animate Contagion), have been thought to have a considerable influence in propagating the disease. On the other hand, it was stated in the public journals, that in some places flies had entirely disappeared on the breaking out of this plague; and yet, within a very few weeks, it has been mentioned in the American papers, that the flies which, at the period of the former breaking out of the disease, had disappeared, were now swarming. Now, all these seem to have been circumstances of not very extraordinary occurrence, which have, nevertheless, been seized upon by persons whose attention has been more especially directed to the phenomena of natural objects for the purpose of discovering the nature of the disease in question. Thus the flight of myriads of green flies was evidently a swarm of aphides, similar instances of which, unattended by the disease in question, or any other malady, are recorded in works upon Entomology. That such view of the subject is not far from correct, may be presumed from the fact, that the appearance of the disease has not, except in the few recorded cases, been attended by those flights of insects; whereas, had they been the real causes of the cholera, they would necessarily have been noticed wherever this dreadful malady had shown itself. Other medical men, however, entertained an opinion, which seems to be perfectly analogous to the supposed cause of blight. Thus Dr. Hahnemann considered that the disease was caused by insects, but which are invisible to the naked eye, and which adhere to the skin, hair, and clothes—a perfect *blight*, in fact, according to the most approved acceptation of the word. Let us, however, look a little further into the nature of the blight of our fruit-trees, and we shall perhaps be enabled, by analogy at least, to demonstrate, that the fearful disease in question does not originate in the manner above noticed.

Now, if we carefully feed the blight of an apple-tree, for instance, under a glass, we shall find that it ultimately becomes a small moth, which moth, after and even without impregnation, if it be a female, deposits eggs of a sensible size, not fertile, of course, in the latter case. Setting aside, therefore, other considerations, it cannot be doubted, that if these eggs were carried about by the winds, they would be evidently visible; but no such thing occurs; all that is perceived is "an easterly wind, attended by a blue mist," or "a peculiar haze or mist, loaded," as it is asserted, "with poisonous miasm." And the same may be said of the eggs of other species of blight, that is, of insect blight, even of the aphides. They are all sufficiently large to be visible by the microscope, if they were wafted about in the air, and yet none are to be perceived. Moreover, it is to be observed, that in the case of the blight of our fruit-trees, it is perfectly well ascertained, that the eggs from which the grubs are produced in the spring are deposited in the preceding autumn; whence it would follow, that if they were merely dropt into the air, they would necessarily be floating until the following spring, during six months wintry weather—a rather improbable thing, we should suppose, regard being also had to the great specific gravity of eggs of insects.

But this hypothesis, in several other points of view, seems equally irreconcileable with nature. If the eggs from which blight is supposed to be produced were really floating in the air, it would necessarily follow that immense numbers of such eggs must perish, such only surviving as happened to be wafted to those particular parts of a tree to which it is to be observed that the blight attaches itself; this will invariably be found to be the tender young shoots and buds. But this supposition is so perfectly at variance with that beautiful regulation in nature by which nothing is made in vain, that it will only be necessary, for its more satisfactory refutation, to notice the great anxiety and care which parent insects invariably manifest in depositing their eggs, even where they are compelled, for the fulfilment of this object, to visit an element totally different from that in which they are accustomed to pass their perfect state; a single example of which may be noticed in the dragon-fly (*libellula*), the females of which may constantly be observed standing upon the edge of a pond, &c., thrusting their long abdomen a considerable depth into the water, in order to place their eggs in security, in such situations where the young, when hatched, will find a due supply of food.

But it may be urged, that although placed in such particular spots by the parent insect, the eggs producing blight are liable, during the six months which are passed in this state, to be carried off by the violence of the winds and weather. If this, however, were the case, all the anxiety of the parent fly would be in vain. Nature has consequently provided against this, by endowing the parent fly with the instinct to cover the eggs with various kinds of envelopes, either with webs spun by themselves, or with materials derived from their own bodies, as in the case of various moths, &c., or from adjacent substances. Most commonly, however, the female leaves her cluster of eggs without any other covering than the varnish with which they are besmeared in their passage from the oviduct, by means of which they are not only firmly gummed to the substance upon which they are placed, but are also defended from the cold and winds of winter, so as to allow the young grubs to burst forth into life and activity in the following spring, carrying destruction in their path.

Thus have we, as we trust satisfactorily, shown that the eggs from which the various kinds of blight are produced, do not float at random in the wind, and that there is not, as it is said, "a blight in the air." We have now, therefore, to consider the prevalence which certain winds appear to have in giving birth to grubs enclosed in eggs deposited by the parent insects upon the spots in which the blight is observed, and here the common observation of mankind, although employed upon effects instead of causes, must be allowed to have some weight. It is not perhaps to be doubted, that the action of certain winds, depending upon variations in temperature, and other metereological changes, which may be even entirely unappreciable by our most minute observations, has the power of bringing forth what is termed blight, the instantaneous appearance of which in vast numbers, at the same time, and the consequent ravages which they occasion being noticed by the commonest observer of nature; hence it is that the sudden appearance of these destructive myriads is at once attributed to the wind, to which, in fact, it is partially attributable, but which, amongst the ignorant, at once obtains the credit of generating and depositing the blight. It has been generally considered by naturalists, that the eggs deposited in the preceding autumn, having been laid at the same time, and exposed to similar atmospheric changes, are necessarily hatched at the same time in the spring, when, in fact, intelligence is obtained by the enclosed grubs, from the peculiar state of the air, that the fitting time for bursting forth from the egg is arrived. This opinion, which, in fact, is by far the nearest to truth of all which have been hitherto given, does not, however, account for the great size which the supposed newly-hatched blight are observed to have attained. The subject, however, has recently been submitted to a minute series of observations by Mr. Lewis, whose researches will be found detailed in the first number of the Transactions of the Entomological Society.

We have said, that swarms of plant-lice upon rose-trees, and other shrubs, are often considered as blight, and intimately connected with them, as well as the preceding subject, is what is termed honey-dew, respecting which Dr. Good observes—"I have seen, as probably many who read this work have also, a hop ground completely overrun and desolated by the aphis humuli, or hop green louse, within twelve hours after a honey-dew (which is a peculiar haze or mist, loaded with poisonous miasm) has slowly crept through the plantation, and stimulated the leaves of the hop to a morbid secretion of a saccharine and viscid juice, which, whilst it destroys the young shoots by exhaustion, renders them a favourite resort for this insect, and a cherishing nidus for myriads of little dots that are its eggs." Now, the opinion which we have already given as to the action of peculiar winds upon the blight-eggs will enable us satisfactorily to explain the sudden appearance of the aphis humuli within so short a time after the appearance of this "peculiar haze," without referring it to the circumstance of the eggs of these insects being carried about by such wind. Indeed, it seems evident that Dr. Good considered that the action of the "peculiar haze" was directed only to stimulating the leaves of the hop to a morbid secretion, which it is not to be conceived would have the effect of producing of itself a swarm of aphides. We will not, in this place, enter into the inquiry, whether the wind in question might not have a twofold influence both upon the insects' eggs and the leaves of the plant, nor will we stop to decide whether the saccharine and viscid juice be a morbid secretion of the leaves, or merely the excrementitious matter of the aphides, the eggs of which had been alone influenced by the action of the wind, and hatched, our object in this article being chiefly directed to an explanation of the sudden appearance of insects, termed blight, and which we trust that we have succeeded in giving, by stripping the subject of the marvellous, and tracing its causes to the well-known rules of insect life. We will only, in conclusion, remark, with reference to the latter part of our observations, that so completely are the aphides dependent upon atmospheric peculiarities, that in the present remarkable season, although these insects swarmed to so great an extent in the spring months, as entirely to stop the growth of the roses, yet, throughout the summer, and up to the present time (September), we have not been able to meet with specimens sufficient to prosecute experiments upon their habits and economy.

BLISTER-FLY. See Cantharis.

BLITE. An English weed, the *Amarantus blitum* of Linnæus. A small inconspicuous plant, usually found growing on dunghills.

BLOOD, *in physiology*, the vital fluid of animals, or that by which they, in all their varieties, are distinguished from the other kingdom of organised beings, the vegetable tribes. It is written that "the blood is the life," and though this must be regarded as a figurative expression, as must also those other cases in which "blood" is used as the designation for different tribes or families of man, or for different races of other animals, yet there is no animal life without blood; the nature and action of this fluid are intimately connected with the development of life, and also of the living organisation and the quantity of living action; so that the blood is more typical of life and living action than any other part of the animal.

It may be considered as the primary or rudimental matter, out of which all the other parts of an animal are formed at the first, and the grand means by which they are kept in repair; and as we have no other abstract notion of life, taken in so wide a sense as to include all living creatures, but motion, or to speak more correctly self-motion, so we find that the energy of life is always in proportion to the degree of motion in the blood. The act of turning into blood is, thus, the specific act of animalisation, the ultimate part of the process of assimilating; and in the formed animal, after it begins to subsist upon food of whatever kind, there is no changing of any sort of aliment into any one structure or part of the animal, without first turning that substance into blood. Nor does it appear that there is in the mature animal, whatever may be its age, any means by which the food, even if it is the blood of another animal, can be converted into blood of the feeder, without a direct mixture with the blood as already formed. Some account of the progress and changes of the food, from its first entering the alimentary canal to the final discharge of the chyle into the vein by the thoracic duct, will be found in the article Assimilation. But, as there stated, the prepared food carried to the vein by this duct, is not only not blood, but unfit for mingling with that blood which goes directly to the nourishment and support of the animal frame, till it has been first sent to the lungs and undergone the action of the air in respiration there; and, though so far as we know, the experiment has not been made, it is highly probable that if the contents of the thoracic duct were mixed directly with the blood in the systematic arteries, or that which goes directly to the different parts of the animal, it would contaminate that fluid, or become a poison.

In all cases in which animal poisons animal, the blood is the part more immediately affected by the virus. The direct poisons which are secreted by healthy animals are deadly only to the blood, taken into it by direct injection or by absorption—which probably takes place to some extent throughout the whole venous system. There are some animals, and animal substances which, taken into the stomach act as poisons; but those which do so when killed in a healthy state, and not subjected to corruption afterwards, are comparatively few; and the appearances which the body presents when so poisoned, very much resemble those which are consequent upon death from animal virus, whether the venom of animals naturally poisonous, or the morbid matter of disease or putrescence. It is the blood which is tainted, and the primary appearances are spots and discolorations on the surface of the body, which if the morbid matter is not too powerful in its operation, and the body is capable of re-acting, often proceed to suppuration, in a manner similar to those diseases which are understood to arise from inoculation.

Poisons from mineral substances, and also some of those from vegetable ones, give rise to similar appearances; but these are, in most cases, if not invariably, secondary, and induced by a disease in the blood, consequent upon the specific action of the mineral or the vegetable poison. The specific action of the mineral poison is, as we might naturally expect, analogous to the ordinary action of mineral upon mineral, that is, it is chemical, it corrodes, or decomposes; and up to a certain point, the action of even the most deadly mineral poison may be not only harmless, but positively salutary. Arsenic itself is, in skilful hands, a very valuable medicine; and so are iodine and prussic acid, though these last are to be regarded as vegetable substances rather than minerals.

The specific action of vegetable poisons, considered strictly as such, is on the sensibility of the animal, or as it is usually expressed, on "the nervous system;" though as the vegetable is not so much removed from the mineral as the animal is, many vegetable poisons have also a corrosive or, as it may be termed, a mineral or chemical action. These poisons, like the mineral ones, are harmless or medicinal, up to a certain point; and those deadly effects may, in most cases, if not in all, be said to be secondary. But, as they are still organic substances, or the products of organisation, they approximate more nearly to direct poisons acting upon the vital fluid than the mineral ones, though their chemical effects are, for the same reason, not so violent. Hence the common notion that active or drastic vegetable medicines are safer than mineral ones of the same power, is both a prejudice and an error; and one which, in the hands of ignorant and impudent empirics (and they cannot be the one without being the other,) is productive of incalculable mischief to the credulous.

Animal virus is, on the other hand, never medicinal; and no active animal substance can be employed in the cure of disease, even in the smallest doses. Animal substances are however much more easily assimilated than vegetable ones; and therefore they can be advantageously employed in regimen, and also mechanically in blunting the acridity of other substances. But wherever an animal substance acts upon the body in any more vigorous manner than that of relieving some of the working structures, or of shielding them from the action of some other deleterious substance, it always acts as a systematic poison. Farther, where any part of the body is destroyed by the action of a distinct animal virus, whether that virus is one of inoculation, or of a disease originating in the system, the part so destroyed is never reproduced; and even a wound which heals by inflammation and granulation, and not by the first intention, always leaves a scar. The case of some putrid diseases attacking the animal system only once, and being mitigated by inoculation, or prevented by inoculation with the virus of another disease, as in the prevention of human *variola* by *vaccination*, whilst the body, in other cases, remains as subject to a second attack of the disease as it was to the first one, is an anomaly which we are not very able to explain, and which belongs to the medical rather than the physiological consideration of the animal economy. But the effects of those diseases of inoculation, whether with virus obtained from the same or a different species of animal, have the same effects, where they destroy ever so small a portion by suppuration. The scar which they leave is never like the scar of a common wound, or that produced by the application of nitrate of silver or any other caustic. Even in the case of vaccination, which may be considered as the most simple of the whole, if the scar which is left be smooth, like that from a common wound or other topical injury by which the system is not affected, the certain conclusion is that the operation has failed, and must be repeated; and the honeycombed appearance of the scar, as if part of the substance were eaten away, is the best, and, after the inflammation is gone, almost the only certain evidence which we have of the success of the operation.

To those who are not much in the habit of reflecting upon such subjects, it may seem that these observations, or the points to which they are directed, have little to do with the popular history of animated nature. But so far is this from being the case, that it is for want of attention to those general means of distinguishing the several kingdoms of nature from each other, and of knowing and describing each by something more profound and permanent than mere external appearances, that people in general take much less interest in the study of nature, and derive much less pleasure, and even profit, from it, than it is calculated to afford; and also, that those who, with but little of the general principles of philosophy, and consequently small capacity for comprehending the action of general principles, drudge at the details of some one department, till they become technical adepts therein, and obtain such renown as this minor species of learning is calculated to win, sometimes jumble together the primary distinctions of kingdom from kingdom, vitiate the whole subject to the ignorant, and make themselves most lamentably ridiculous in the eyes of the few who are better informed.

The action of mineral upon mineral, vegetable upon vegetable, and animal upon animal, may in so far help us to the knowledge of each in itself; but we can see the limits of each, and understand their operations fully, only by attending to their action upon each other. Now, if the preceding sentences of this article have been read with even a moderate degree of attention, it will be seen that, when we take the action of each of the three upon the animal system, in those cases in which that system itself is most exclusively passive, it follows that, on this account, the nature of the one which is active can be best ascertained. But, the only cases in which the animal structure is passive to the action of minerals and vegetables, are those in which these act as poisons, and a very little reflection will show that such must be the fact. A mineral acts only as matter—a vegetable only as organised or growing matter, which, when it ceases to add to its volume in some way or other, ceases to perform the functions of an organised body—but in the animal there is a distinct power, apart from growth or addition of substance, which, among its other functions, renovates or replaces the old matter, which has become unfit for its economy, by new matter obtained through assimilation; and while the animal continues capable of effecting this renewal it lives, even though the body should be gradually diminishing in volume, as is the case in the decrepitude of man, and of some other animals, when allowed to perish by natural decay. There is nothing similar to this in the other kingdoms of nature. When a mineral diminishes in size, it is by decomposition, or by a closer union of the parts; and though there are apparent decreases in the volumes of vegetables, these take place only when the proper vegetable action ceases. When the heart, or oldest part of an aged tree, decays, the portions which remain alive make their seasonal additions of wood in the same manner, although not always to the same extent, as if the whole tree were in action. So also, when the bleak winds appear to "eat the grass off the fields," it is no more than a temporary fainting of the plant, so to speak, which, if carried beyond a certain limit, would destroy its action altogether.

Thus, if we would characterise and distinguish the three kingdoms of nature by their actions, which are, for many reasons, the best means for such a purpose, we must say that the vegetable is more active than the mineral, and the animal more active than the vegetable; and therefore, when the action between one of one kingdom and one of another is neutral, that of the more active must so far predominate over that of the less, as to give its own character both to the mode of action and to the result. The victory, so to speak, is so decidedly on the part of the more energetic of the two, that it may be said, and in common language it is said, to *use* the other.

We have seen that a mineral acts upon the animal body as if that also were a mineral; and though we have but little knowledge of the mode in which vegetables act upon each other, yet they exert an action upon the animal system so different from that of poisonous minerals and animal virus of whatever kind, that it may be considered peculiar and characteristic. Even in the case of those "tree-nettles," and other stinging plants, the action of which upon one part of the body is followed by a rash or a swelling of other parts, or even of the whole, the effect appears to be secondary, more confined to the surface, and less affecting the general system than the animal poisons. A numbing or suspension of the sensal energy, rather than a corruption of the system through the medium of the blood, appears to be the effect even of these. When, however, one animal acts upon another, not by specific organs, which have a mechanical effect, but physiologically, it acts on the blood.

As life is known to us only as motion, so the blood of an animal is the indication of life only in so far as it moves or circulates. This motion is faster in some animals and slower in others; there are some in which it is hardly perceptible, and there are others in which (as in the case of hybernation, and the more temporary one of fainting) it appears to be merely suspended. But when these suspensions take place, whether for a longer or a shorter period, all the other functions of the animals are suspended also. The first sign of life in the hybernating or the fainting animal is a renewal of the circulation.

Thus we are warranted in concluding, that the circulation of the blood is the original and characteristic function of animal life. Nor are we left to inference on this point, though inference here comes as near to demonstration as it possibly can come. It is true that, in the perfectly developed animal, all the functions, and all the systems by means of which those functions are performed, are so intimately connected, form so much parts of one whole, which can exist only as a whole, that if any one of them is deranged, it deranges all the others. But, when we examine the animal in its rudimental state, and trace its progress towards maturity, we find that the system of the blood is in all cases the first which is developed. When we say " in all cases, " we of course mean all those which observation can reach, for there are some which we have no means of observing, and others which, from the colour of the blood, we are unable satisfactorily to observe. In the case of all animals which have red blood, blood and blood-vessels are the first indications of rudimental life. This is very apparent in the eggs of birds; and, though there observations are not so easily made, the same is the case in the eggs of fishes. When the rudiment of the chicken is first discoverable, it is as a heart and blood-vessels; and, as was long ago observed by Haller, these can be distinctly seen before there is a single vestige either of brain or of lungs. This first rudimental stage may be considered as the very lowest state of animal life, the simplest one of organisation in the chicken; and as there are different degrees of perfection, or, to speak more accurately, of organic development in animals, according to the different parts which they are to act in nature's economy, it is not only perfectly consistent, but even in strict accordance with what we observe of that economy, that there are animals which never get beyond this first rudimental stage of organisation. But we can trace nothing of the kind in vegetables, whether in their rudimental stages, or when they are most fully developed. Therefore we have the character of the animal, as such, stamped at the first development of the germ, and in the simplest of the kingdom: or rather, that character is of itself the development—the animal as distinct in kind from every other production of nature. Therefore, we must discard all the attempts which have been made to confound the physiology of plants with that of animals, and all the conclusions which have been verbally drawn from those attempts, as equally repugnant to rational theory and practical observation, and wholly unworthy of any one having the slightest pretensions to philosophy.

We are in the habit of saying that certain systems or structures of animals, or that certain animals altogether, are organised upon particular parts, as that vertebrated animals are organised upon the spinal column, that other races are organised upon the alimentary canal, and that others again are articulated upon the crust or the integument. In as far as the action of the animals is concerned, these references of particular organisations and marks of organisation to certain structures, as organs or bases, are no doubt true; but it is to be understood that the primary and grand organisation of every animal is upon the system of the blood, as that in all the species is the universal elementary matter out of which every animal structure and animal whatever is formed. We know not how far absorption at the surface may, in some cases, assist internal assimilation, or even upon emergency render it unnecessary, just as we do not know how far the application of air to the surface of the blood vessels may assist the lungs or gills, or even act as a substitute for them in respiration; but we cannot imagine a case in which the body of an animal can either grow or be nourished without a circulation of the blood. We have reason to believe, too, that, in all cases, the circulation of the blood, without which there can be no action of animal life, is carried on by muscular exertion, over which what is called the will of the animal has no controul;—and, by the way, this furnishes an unanswerable argument against the existence of *will* as usually defined by writers on physiology, whether animal or mental. Those actions of the animal frame which are supposed to result from the exercise of this imaginary power of will, are all immediately muscular, or ultimately resolvable into muscular action of some kind or other; for even the most doting believer in this self-contradictory notion never went so far as to alledge that he could " will a thought;" and yet as all human action is the result of thought, even in those cases which are called " thoughtless," there is no need for inventing an original power, which demonstratively has no concern with the origin of the business, to bring up that portion of the rear which must follow the unwilled part. As well might he who has the fountain say that he wills the stream, or he who has the tree claim the power of willing the apples. The cause of the outward act, whether in man or in any other animal, is the inward impulse; and though we may not be in every or in any case able to trace it to its primary origin, no finite being can create the impulse any more than it can create itself. As the animal impulse must be supposed to be always stimulated by something material—something which has an entity or separate existence, and not by a relation which is cognisable by mind only, we may naturally suppose that it begins with the development of the vital system, in the first pulse of the rudimental heart; but that there is not any external knowledge of it till sensation, either general or located to a particular organ for a particular use, connects it with the external world.

In this, as well as in every other point of view, a knowledge of the blood and vital system of animals, as their grand characteristic, becomes of the highest importance, not only to the proper understanding of all the other parts of the animal economy, but in itself as one of the most interesting subjects in nature, and one in which the Divine wisdom and power are more strikingly displayed than in any other part of the material creation. We can in part understand the mechanical structures of animals, and in part imitate them; but when we come to consider the blood, we may well be lost in wonder. We find it primarily, and as we may say, in vessels that do not belong to the new animal, when that animal is in that twilight dawn of its being, the mysterious darkness of which no light of human philosophy can dispel or even penetrate.

This blood is constant to the grand division, the class, the group, and all the minor subdivisions of animals down to the species and the variety; but in no one animal, excepting those which are propagated by what may perhaps be considered as mechanical divisions of the bodies of existing ones, can the blood of one generation be considered as a portion of that of the preceding one. In all other cases there is a line of separation, a mysterious boundary, wholly beyond the reach of human ken, which makes the young, whether viviparous, oviparous, or of that mixed mode of production which partakes of the characters of both, a distinct and separate animal: *of* the parent certainly, but not *a part* of the parent. The blood is new blood; and because the mystery of the transformation will not unveil itself to the most searching eye of philosophy, every new animal which is brought forth, be the mode, as far as observable, what it may, is as much a miracle to human understanding as the production of an animal where parent there is none. The thousandth, the millionth, the *n*th generation (that of which no arithmetic can express the number) thus carries the mind as necessarily and immediately to the Creator as the consideration of the primal parent which His creative fiat spake into being. We cannot in this or in any other case follow the chain of natural causes till we come to the primary link—the part, so to speak, at which the springs of life are touched by the immediate finger of God; but if we follow the contemplation in the true spirit of rational and at the same time devout philosophy (and here these are not two), we feel something more than mortal beam upon the mind. But it is a glory too radiant for material eyes, and will not remain till we question it; yet it leaves a hope which takes the grief out of all the vicissitudes of our mortal life, and destroys all apprehension of its close.

This is the grand climax of the study of the blood, and indeed of the whole active principles of the animated tribes; but the steps to it are also pleasant as well as profitable, and they are both open and inviting to our inquiry. We shall, therefore, offer a few more detached remarks on the nature, or rather the functions, of the vital fluid; and as these are most striking in the warm-blooded animals, we shall refer chiefly to them. It is necessary here, however, to make a very short explanation, as well to prevent the uninformed reader from being misled, as to keep our meaning from being perverted by the captious. When we apply the term "vital fluid" to the blood, we do not mean to assert that the blood is the seat of life, or that, considered as blood and apart from the organisation of the animal to which it belongs, and from the living action of that organisation, it is possessed of life of any kind, or in any degree. The blood has no sensibility under any circumstances, and no life or capacity of acting wholesomely upon the system, unless when it is in healthy circulation in its own vessels. And when there is what is popularly called a diseased state of the blood, it is not to be understood that it is in itself vitiated, even when it is mingled with the venom of a reptile, or with any other animal poison, whether imparted to the system or produced in it. It is not the blood itself which is poisoned in these cases, it is the blood which poisons the other parts of the system, by becoming unfit for acting in concert with them, or, as we say, stimulating them in the way which is necessary to the healthful action of the whole body in all its systems. If these systems preserve their functions, the blood may partially die (so to express it) within the system, without the smallest injury to the action, or the smallest danger to any part of the system. In the case of partial bruises which are, according to the common saying, "black and blue," there is always a quantity of blood coagulated, which in time may be extracted as a dark powder or a sort of cake, under which a healthy skin has formed. Something similar takes place in those discolorations or patches of the skin, which are vulgarly known by the name of "dead men's pinches," and which, though they are unseemly while they last, are really the results of healthy action in the system, sufficient to throw offensive matter to the surface. The same sort of process often takes place in wounds, which are healed over without being cleared of extravasated blood. The writer of this article had a personal instance of this in a pretty deep incised wound in a fleshy part of the body, which healed over, not exactly by the first intention, but in a short time, and with no great pain. For several years there was an occasional itching, with sometimes slight pain, under the scar; and about eight or nine years after the healing, the scar became black like a bruise; and after an intolerable itching, the integuments gave way, and a pellet of coagulated blood was discharged, after which there was no more itching or pain in the seat of the scar. Cases of this kind often occur in different parts of the body, without any wound or other external injury. They are not unfrequently formed in cases of aneurism, sometimes in those of varix; and they occur not only in the common fleshy parts, but in the heart and even in the brain. When they occur in these inner parts, which are considered as more eminently vital, ignorance sometimes transforms them into worms of strange colour and nature, and sets them down as the causes of disease and even of death, though they are perfectly harmless, and have no tendency to extend to the other parts of the system that death which they themselves have undergone.

These facts, and many more of a similar nature, could be adduced, to show, that when we call the blood the vital fluid, no distinct or specific vitality, at all analogous to that of animals in which organisation is much developed, and sensation or action of any kind vigorous, can be imputed to it. This might be inferred also from what has been said of the blood being the beginning or rudimental part of life, and a system of blood-vessels of some sort or other always being present in the lowest state of animal development, whether in the fœtal state of the animal or in the mature state of the less developed ones. All that empirics say about diseases of the blood, as such, and nostrums for their removal, must therefore be regarded as falling within the category of nonsense, which on the subject of health and disease is an exceedingly ample one. Still the blood may take up, either by inoculation, by absorption, or by the common process of assimilation or chylefaction, substances which render its action, upon the containing vessels and the system generally, pernicious instead of wholesome; and in very many instances in which curative preparations are exhibited, they are understood to act upon the system through the medium of the blood, which is sometimes reached by the process of chylefaction, sometimes by that of absorption, and sometimes again by tension or by relaxation of the vessels, according to circumstances. These views of the subject and means of acting upon the system belong to medicine rather than to natural history, though some knowledge of them is necessary for the prevention of mistakes and errors in that science.

Nature and Action of the Blood. In briefly glancing at this part of the subject, it is not necessary to enter into any investigation of the chemical nature and composition of the blood, because the action of that fluid upon the animal system is not chemical, that is, it does not obey the same laws which are obeyed in the chemical action of dead matter. Indeed, the whole action of the animal system is in opposition to these laws. The energy of life, though undefinable in any other way than by its phenomena, is more mighty than these laws, and holds them suspended as long as the organisation of the individual is capable of obeying the living impulse. When disease invades and deranges the system, the natural or chemical powers or properties of the component substances of the organisation begin to operate, and the disease takes more or less of a putrid type, so much so that, in certain states of disease, it appears that the matter given out by the affected body, even when in the form of insensible perspiration, and not discernible by any test, is capable of communicating the disease to healthy bodies in that mysterious way which we call infection. But it is not till the whole body has ceased to live, and a time, longer or shorter according to circumstances, has passed over it (always shorter the more the disease has of a putrid type, and the more energetic the action of nature around), that it yields wholly to the laws of inorganic chemistry—of that chemistry in which alone we can make experiments, and in so far explain principles by means of these experiments.

From these considerations, it is evident that, if we attempt to apply our common chemistry to investigate the composition of the blood, and thence venture to give explanations of any of the functions of life, we are in error; because we are attempting to explain the actions of the living body by means of agencies, the suspension of which is involved in the very notion and definition of life, and which cannot, by possibility, be exerted upon any part of the body till life itself is extinct.

It is necessary for us to be constantly upon our guard lest we should confound dead and living action, because there is, not in the ignorant only, but in the scientific, and indeed in them more than in the ignorant, a constant tendency to this confusion. This arises from the succession of fashions in philosophy, which follow the same law as fashions in common matters, but are far more inveterate, and we may add, far more mischievous, because they affect the whole character of society, intellectual and moral, while the others, if they do this at all, do it only at second hand. When the principles of mechanical philosophy were in their prime, and, as it were, held the whole field of science, it was the fashion to attempt the explanation of everything upon mechanical principles, and not only the action of the living body, in all those functions which are necessary for the preservation of the individual, but sensation and perception, and even thought, were attempted to be explained on the same laws which determine the motion of the planets in their orbits, or the tidal motions of the ocean waters. When chemical science, (the principles of which being of a more complicated and less obvious nature, necessarily came after those of mechanical philosophy,) had made such advances as to take the lead and become the fashion, the whole action of the living body was considered as chemical, and explainable by the laws of chemical attractions and repulsions, with their attendant compositions and decompositions. This was not, in an intellectual point of view, carried so far as the other; for no one ever gravely supposed that sensation, far less thought, was a result of chemical action, or ventured to recommend alembics and crucibles with sand-baths and fires, as appropriate substitutes for the old and vulgar process of thinking. They did not even attempt, by chemical means, to give sight to the eye or hearing to the ear, as had been partially done by the application of mechanical instruments, but in so far as what may be called the proper functions of the body, those which develope its organisation and preserve it in a living and healthy state were concerned, chemistry was the rule of action, and when the body became diseased, chemistry was the grand means of cure. It is true, that a mixer of medicines had been called a "chemist" before this time; but a chemist, in the general sense of the trm, means one who is possessed of, or who deals in secrets; and in the composition of medicines there are some real secrets, and many more which belong to that class which are most safely kept—those in which there is nothing that can be revealed. In addition to these two general modes of endeavouring to explain the functions of the living body by means of principles, the resistance of which forms the best definition of life, there were always minor modes of a transcendental nature (or which could not be reduced to any principles) breaking in still farther to confuse a subject which is certain at all times to claim much attention, but which has at no time been explained, or even clearly defined.

Life, that which puts into action all the organs and structures of the animal body, is so interesting in wild nature, and so useful in domestication, is the portion of creation which all are most desirous of understanding; and, whatever may have been the case with any other subject, there is no human being, learned or unlearned, that has not thought and speculated about this one.

> "Who, to dumb forgetfulness a prey,
> This pleasing anxious being e'er resigned!"

is true, not only when we consign to the earth the mortal remains of those who have been dear to us, but of our own living bodies, and of those of all the creatures which live around us. Hence, be it as crabbed or as absurd as it may, a book upon the functions of life, and more especially one upon the functions of human life, is sure to find readers, upon the same principle that he who pretends loudly enough to cure human disease is sure to find encouragement, be his knowledge ever so limited, and his nostrums ever so baneful. This universal craving might be, and no doubt was intended to be, one of the great inlets of knowledge; but unfortunately it is just as greedy of error; and hence, as is the case with all those which, under proper regulation, are capable of effecting much good, it is made the means of much evil.

Nor is it easy to say whether the pretender, who seeks merely that living which he is incapable of obtaining by honest industry, or the man of science, who seeks for fame in an honourable way, has done the most mischief here. The latter of the two is deeply learned in the laws of matter, and, like a pedant who darkens language, naturally obscure enough, by his constant efforts to show his learning, or a man who has become so much inured to the technicalities of his craft, that he speaks in an unknown tongue to all who are unacquainted with the minutiæ of that craft—he will be constantly introducing his mechanical philosophy and his chemistry, whether they are consistent with the subject or not.

Chemistry, in that form which admits of experiment, and can be reduced to a system in the schools, cannot in any way help to explain one single function of a living animal. Even in the formation of carbonic acid in breathing, the result is a chemical result certainly, at all events, it is a result which could be obtained by means of a common chemical experiment,—in other words, a product similar to that which results from the process of breathing could be obtained by other means; but the process is not the same, and we dare not call that chemical; it is similar with all the operations which are carried on in the living body; in as far as matter is put in motion they are mechanical, and in as far as they tend to decompose any substance they are chemical; but the energy by which these are accomplished is neither the one nor the other—it is physiological, belongs to the living state only, and when that state is at an end, it exists no more, and leaves not upon matter any trace of its existence.

In what may be called corporeal physiology, to distinguish it from the more subtle subject of the physiology of thought, the consideration of the blood is by far the most important one; and therefore, if we are not strictly physiological in it, if we call in the assistance of chemistry, or of any thing foreign to the nature of living action, we lay an unstable foundation, and the whole structure of our future knowledge becomes of small value. In the following remarks on the nature of the blood, we shall therefore consider the physiological phenomena as the foundation and principle of the whole, though we may have occasion to advert to some of the chemical ingredients of the blood in illustration, but only as proofs that there is an action, not as explanations of either the cause or the manner of that action.

Blood, when immediately taken from the vessels of a living animal of any of the more completely developed vertebrated classes, appears a homogeneous fluid, of somewhat viscid consistency, rather heavier than water, of a red colour, and of the temperature of the body from which it is taken, in man this being about 98° of the common thermometer. This, while it retains its primary heat, may be considered as living blood, or the nearest approach which direct observation can make to it in the vessels of the animal; but whether it is exactly the same, we have no means of ascertaining; for blood is a fluid so susceptible to action, and capable of being acted upon (or acting) in so many ways, that we can have no positive knowledge of the effect which the contact of the atmosphere, however momentary, or the mere taking of it out of the circulation, nay, the mere momentary stoppage of that circulation, may have upon it.

This consideration tends very much to paralyse, at the outset, all our inferences from what we can discover of the blood when out of the system, of the functions which it performs, and the manner in which it performs them, when in the system.

After blood has been for some time out of the vessels, it separates into two parts, the one a yellowish fluid, called serum, and the other an accumulation of red particles, called crassamentum, or clot, which floats in the serum, and may be divided by a knife, which the serum cannot be. The experiments on the subject have not been made with sufficient precision, or in sufficient number; but it would seem that this coagulation of the blood, or separation of the serum from the clot, takes place soonest in the blood of those animals which are the most perfectly developed in their organisation, and which have the circulation most rapid; but this is still too vague for allowing any conclusion to be safely founded upon it.

If, during the time that it is coagulating, the blood be gently agitated or stirred, the clot acquires a fibrous consistency, which, when closely examined, has the appearance of a kind of net-work, or of short feathery fibres, which take hold of each other in all directions. If, instead of being gently stirred, the blood is violently, or even briskly agitated, the clot does not separate either in a uniform mass, as when left still, or in a fibrous tissue, as when stirred or agitated gently.

It is obviously not the presence of atmospheric air which produces this change in the consistency, and apparently in the composition of blood, for, as has been said, blood coagulates in the interior of the body, sometimes extravasated, and sometimes in its own vessels; and it would seem that, in those cases, it is the clot of the blood which remains, the serous part being taken up by the absorbents. Hence it is probable that, in all cases in which inflammation, suppuration, or gangrene follow upon the extravasation of blood in the system, one of the causes, at least, is the incapacity of the absorbents to take up the serum, for in those portions which are found harmlessly bedded in the substance of the body, it is the clot only which is left.

If the fibrous clot which is obtained by gentle agitation of the blood be repeatedly washed in water, the colouring matter is entirely removed, and the fibres, or *fibrin*, as the substance is called, become nearly colourless, and is tough and elastic. Fibrin, in the same state of adhesion and elasticity, cannot be obtained either from blood which is left at rest, or from that which is subjected to violent agitation; but what correspondence there is between the degree of agitation necessary to prevent the separation of the fibrin, and the rate of healthy circulation in the animal from which the blood is taken, has not been ascertained by experience, though it is unquestionably a point of very great importance, and the one, the solution of which is most likely to throw light (if any inquiry can throw light) upon the manner in which the repairs of the different animal structures, or even their formations at first, are elaborated from the blood.

We have it established by direct observation, that, where blood is allowed to remain still, or where the agitation or stirring of it is below a certain point, the clot separates in a viscid and jelly-like mass, but without any appearance of organic structure. We have also, by rational inference from what takes place in the living body, where the serum of extravasated or otherwise stagnant blood is, and also where it is not, taken up by absorption. Farther, as the blood when in the vessels has no sensation, is not organised, and therefore though the means of life, and the element out of which all the organs of living structure are made and repaired, we cannot conclude, at least we have no just ground for concluding, that the blood, when in the vessels, is very different from what it is when immediately drawn from them; but that, if it could be kept from atmospheric contact, the same temperature as it had in the healthy body preserved, and the same rate of motion kept up as it has in the circulation—then the blood would, for a time at least, be capable of the same action which it has in the vessels. Hence, we may conclude, in so far as any conclusion can be drawn from evidence which consists in great part of probabilities only, that there may be a state of the circulation so lagging, that the non-fibrous clot will have a tendency to form, and may actually form in the vessels; and as we may presume that any state of the system which induces this lagging circulation, must be accompanied by such diminished action of the other parts, as that the absorption shall not take place, this would bring the whole system to that state in which we have said that inflammation, suppuration, and ultimately gangrene, take place topically, and dissolution would be the inevitable consequence.

This is probably the final stage in very many fatal diseases; and it appears to attend the whole course of those which are technically called low and putrid, or those in which the pulse is below the healthy quantity, in velocity, in volume, or in both. We have some corroboration of this, in so far as the dead subject can be admitted in corroboration of what is supposed to take place in the living, in the fact that the flesh of animals, even when killed in the healthy state, becomes much sooner putrid if the blood remains in it; and that the flesh of animals labouring under putrid disease, even though killed before that disease becomes mortal, or even altogether suspends any of their common actions is unwholesome, and has more or less the effect of a poison on those who eat it. This is farther corroborated by the fact that the diseases which are superinduced by tainted meat are always of the low or putrid type.

The common saying that "extremes meet" is in so far verified in this matter; for many maladies which begin with an excessive action of the system wear it out, and assume a low and putrid character before dissolution. And where there is still some strength of effort in the system, we find that nature turns that effort into an attempt to make the morbidity topical—to throw it upon some one part, and thus relieve the general system till it can rally and maintain the life; and though these efforts fail, of course, in all cases which end fatally, perhaps there is no case in which they are not to some extent made, unless it be in those where the whole system is so equally and gradually worn that it yields to the very first derangement, and the fortunate subject drops off, as the matured leaf falls in autumn, without a groan and without a pain.

In this we can trace one of the deviations in the current of the blood in the living body from that wholesome state in which the vital fluid is always ready for the furnishing of *fibrin*, which we may, perhaps, without much impropriety consider as the first or elementary product of complete assimilation, —the first stage of organisation, or the general material of which all the varied structures in the body of an animal are formed, and by the constant application of which, according to the degree of waste that takes place, they are kept in repair.

But we have also seen, that where the recent blood is agitated beyond a certain degree, it is also rendered incapable of forming fibrin, and retains its fluidity without any tendency in the two parts to separate. And, as this is the more readily effected by artificial means the more recent that the blood is, we may naturally suppose that a circulation may take place in the living body so rapid as to produce the same effect. That the indication of this must be an increase of pulsation, which is the only means we have of judging of an increased circulation, is perfectly evident. This is produced by violent action of whatever kind, whether it arise from external or internal causes; and though the blood, when circulating with this unnatural rapidity is not primarily so prone to putrefaction as it is in the opposite state, yet it is just as incapable of supplying the requisite nourishment to the several parts. At the same time, the more rapid circulation, which must be attended with increased action of the whole body, tends to fatigue and wear out the labouring vessels, deprived as they are of their proper support and nourishment by this violent action. It is from this that we see how, if some part of the system does not give way, and produce either dissolution or cure, according as the part which yields is vital or not vital (in the ordinary sense of these words,) the over action of the system, or what is technically called a disease of inflammatory type, should in the end degenerate into the low or putrid one. But there is always an effort of the system to save itself, in this case as well as in the other; only, as the diseased action is the reverse, we may expect that the symptoms of the effort will be different. Such is the case: the violent action of the system, the increased pulse and augmented heat have a tendency to produce topical inflammation and suppuration, and if this action takes place in time, and not in a vital part, it removes the systematic disease, and what remains may be treated nearly in the same manner as if it were a topical injury arising from an external cause. It is easy however to see that it must be treated with far greater caution. In the case of such a result from external injury, the system, by the very fact of being able to keep the injury on the confines, shows its soundness and power of resistance; whereas, though the system is able to throw a general malady to a topical situation, there is always a degree of exhaustion of the system produced by the effort, which makes any topical application which has a tendency to drive back the malady upon the system, peculiarly dangerous. We have instances of this in the "driving in," as it is called, of a rash, in the checking of perspiration, and in an almost endless variety of cases. If a topical disease is original or primary, we may attack it in its locality; but if it is symptomatic or secondary, we must take care lest we deprive nature of her own means of cure.

Some of the remarks which are contained in those latter paragraphs may appear to have a medical more than a physiological air; but the subject is of such a nature that we cannot understand even the elementary action of the blood, without reference to the same subject in different states of the circulation; and if one of those be the healthy state, the other must of necessity be a diseased one. We have it indicated in the fact that the recent blood will not *fibrise* (to coin a word for the sake of brevity,) if it is either too little or too much agitated; thus we obtain a sort of foundation, though not a very perfect one, for our physiological consideration of the blood.

Between these two limits, both equally fatal, and varying in the case of almost every species of animal, there is an average ratio of circulation which may be considered as the circulation of health, and which varies as much in the different races as those limits between which it may be said to be the middle point. The circulation in the race is always the more rapid, the more active and the more continuous in action, and also the more completely the organisation is developed; and in the individual it rises with increased action, whether external or internal, and sinks with repose. It is more rapid in the young and growing state than when the mature stature is attained; and those animals which are subject to short fits of very violent action, with long pauses between, have corresponding differences in the action of the system of the blood.

Birds, as having to perform the most violent action of any of the vertebrated animals, have the most rapid circulation; and among them the vegetable feeders, which have most labour both in the finding of their food, and in the assimilation of it, have the most rapid circulation and the highest temperature. The mammalia follow next in order, and after them the reptiles, and lastly the fishes. That such is the general or average distribution is true; but there are so many anomalies in all the classes, arising from the adaptations of different animals of the same class to different latitudes and different situations, that no theory which descends to more minuteness than that of a general connexion between a rapid action of the system of the blood, and a corresponding activity in the general habits of the animal, can be implicitly depended upon.

Something similar as to the correspondence between rapidity of circulation and energy of action, may be traced among the invertebrated animals. Of these, the winged ones have the warmest temperature, and thence, from the general analogy, we may premise that they have the most rapid circulation; and in all cases the supply of food required is in proportion to the circulation. Not indeed as regards the quantity taken at one time; for many of the species which feed most voraciously when they do feed, are capable of bearing the longest periods of abstinence. The blood of the invertebrated animals is, in most cases, bluish or whitish, and but rarely red; but in what respects it differs physiologically from the blood of vertebrated animals, we have no satisfactory means of ascertaining; and, as we have already said, chemical analysis can be supposed to throw little or no light upon the action of this fluid.

Many conjectures have been made, and many theories proposed and overturned, with regard to the specific action of the blood; but the subject still remains, and will probably for ever remain, involved in great obscurity. There are some circumstances which give at least a semblance of probability to Hunter's hypothesis of "the life of the blood," that is a vital action *in* or *of* the fluid itself, without a pre-existent cause, dependent upon or residing in any organisation. This may be inferred from the facts already mentioned, that the first rudimental appearance of the germ consists of blood and blood vessels. But this is not enough for the establishment of the hypothesis. The blood cannot exist or act to any useful purpose without the containing vessels; and therefore, though the muscular structure of the heart (for the heart in all animals, of whatever class or kind, is muscular) may not be formed *before* the blood which it contains and propels, yet we cannot suppose it to be formed *after*. Besides, though these may be the first rudiments of organic structure in the young animals, they are not the original germ, nor can their action be regarded as the first action of the germ. The germs of some animals can retain their vitality for very long, and even indefinite periods of time, and some of them admit of being boiled or frozen, or both; and still, under favourable circumstances, they awaken into life. Towards the awakening in these cases too, no further interference of an animal is required, so that in some of its forms, animal life can lie dormant, in a very low state of organisation, (if indeed we can with any propriety call eggs organised bodies,) a state in which there is nothing developed which we can call either blood or a blood vessel. When the egg, which is the usual form of those permanent germs, is placed under favourable circumstances, the life in it begins to act; therefore we might as well predicate life of the heat and humidity, or whatever other circumstances it may be which stimulate the germ and produce the development, as of the blood vessels and blood which are the results of a previous action. This action is no doubt very simple and rudimental. But still, however simple and rudimental it may be, we know that it must take place; because we have the visible results of it in the vessels and the blood, and though these are the results, and not the action or its cause, still all the evidence which we can have of any action or any cause of action, however powerful we may imagine it to be, is precisely of the same description. We know, and we can by possibility know nothing but results; and yet we are so constituted that we can no more suppose any result to take place without a cause adequate to its accomplishment, then we can believe any one object to be at one and the same time in two different places, or to be itself and, at the same time another.

Hence it is impossible for us to believe that the primary and rudimental life of any animal as a germ can be seated in that blood which does not begin to exist till after the action of the germ and in consequence of it; and therefore the blood cannot be the depositary of the original life; and if we suppose that it subsequently becomes endowed with a sort of organic vitality, we are not entitled to consider the blood as exclusively or pre-eminently endowed with a vitality which obviously belongs to the whole animal as an organic structure.

If the expression can be allowed, the apparent vitality of the blood appears to be the result of muscular energy, for when the heart is no longer able to propel the blood, that fluid stagnates, and ceases to perform its function, and life is at an end. Thus as, on the one hand, what we term the life or living action of the blood, takes place only consequent to a previous action, so the cessation of life in the blood appears to be preceded by a cessation of life in that organisation, by which the blood is circulated over the system.

There are some rather curious analogies which would lead us to suppose that there is some very extensive connexion, or at all events resemblance, between the fibrin of the blood, and the muscles, and also between the serum of the blood and the membranous tissues of the body. In many animals the muscles approach to the colour of blood, and they are the only parts of the animal which do so. Little useful inference can indeed be drawn from this, because the muscles of many of the red-blooded animals are white, or nearly so; and all muscles may be made white by repeated washing, while the fibrin of which chiefly they are composed continues unchanged. The same has been remarked of the crassamentum of blood; and when the two have been thus freed from colouring matter, they appear as if portions of the same substance.

There are also some curious coincidences between the coagulation of the crassamentum of the blood, and the contraction of the muscles. They are both operations which we do not understand; and though we call the one an attraction which those particles of the blood which are fit for forming fibrin have for each other, and not for the particles of the serum, or for the coats of the vessel in which the blood is contained, and the other irritability, or any thing else, or though we call each a different kind of attraction, or both the same kind, only modified by the different textures of the substances in which they act, we make no progress whatever toward the understanding of them. We have more words certainly; and those words may, as words often do in other cases, satisfy the ignorant, and lead them to conclude that we have more knowledge than they, but they would not make us one jot the wiser.

But though this very peculiar and incomprehensible action takes place in different substances apparently, and also in different states of those substances,—as contraction in the living muscle, and coagulation in the blood after it is removed from the body, or when it has become stagnant,—yet it is possible that they are one and the same action, differently modified. That unnaturally violent contraction of the muscles to which the name of cramp is given, bears nearly the same relation to the healthy action of the muscle, that coagulation bears to the healthy state of the blood. It appears, from the phenomena which occur in recent blood, and from its consistency when it is taken from the vessel of the living body, that there is no fibrin ready formed in it, into any thing that we can call an organic structure even of the most rudimental kind. There is only, so to speak, a capacity in the particles to form this substance, under circumstances which are favourable to it. If the fluid passes quietly into a state of repose, there is coagulation, but not the formation of fibrin, nor can any future operation turn the jelly-like substance thus formed (which however is not jelly,) into fibrous matter. So also if it is violently agitated, the tendency to form fibrin is destroyed, and no subsequent treatment can then favour the spontaneous coagulation. It is said, that if the agitation is violent enough, the uncoagulable result acquires generally a considerable degree of that milky odour (but not the colour of course) which the serum of blood gives out when heated. It is also said to have some resemblance to the catameniary fluid, which, though of the colour of the vital fluid, is understood to be really a secretion of the mammæ, incoagulable, and not forming fibrin by any treatment. It is to be regretted that the experiments of the late Dr. John Smith, of Edinburgh, upon the nature of this secretion, should have been lost to the world by his premature death; for it is a subject which, worked out with due care, and without hypothesis, is calculated to throw light upon some of the most curious points in physiology, more especially the unknown bourne which separates, and at the same time connects, the blood of every two consecutive generations. This is a subject, however, upon which, for obvious reasons, we cannot enter in a popular work.

In like manner as that portion of the blood which is predisposed to the formation of fibrin passes into coagulum, when the blood as it comes from the living vessel is allowed to rest, so the muscle, when it passes from the living to the dead state, under ordinary circumstances, passes into a state of rigidity; or all the muscles pass equally into a state of contraction, from which they do not again relax till their substance begins to yield to the ordinary action of decomposition. Here also there is a resemblance between the coagulable portion of the blood, in so far as we can suppose a resemblance to be traceable between a fluid apparently homogeneous, and a soft solid made up of fibrous fasciculi.

One of the most remarkable evidences of this similarity in the blood and the muscle, is to be found in the similar effects of certain violent kinds of action upon both. Almost all those actions differ in the agents by which they are produced, and indeed in most of the circumstances, but they agree in preventing the coagulation of the blood and the stiffening of the muscles, and they also all, in so far as we can understand the rationale of their action, agree in bearing some resemblance to that rapid or violent agitation of the blood which destroys its tendency to coagulate when out of the body. It is rather remarkable, and should show us that, in our physiological investigations, we ought not to lay too much stress upon mechanical or chemical appearances or effects, that some of those actions are merely momentary, and some of more prolonged duration, some of them act by direct mechanical agency, some have nothing of common mechanics in them, some are produced by vegetable agents, and some by animal ones, and some have their proximate, if not their primary causes in the body itself.

Gun-shot wounds may be mentioned as one instance, and the more speedily that death ensues after the receiving of the wound, the state of the body is the more completely relaxed. The wind of a cannon shot when it causes death, which it sometimes does when it passes very near, has almost the same effect in relaxing the body as a gun-shot wound; and instant death from a blow on the stomach, or from a concussion or other injury to the brain has still the same effect. These last two instances are against the hypothesis that either the blood or the muscles can be the peculiar seat of life; for the injury done to the source of chylefaction or to that of the nervous energy produces the same effect on the blood and the muscles, as other injuries which are understood to go more directly to those parts of the body. Perhaps the most complete prostration of the body, in which the muscles remain quite soft and the blood liquid, is that produced by electric matter when its violence is sufficient to produce death, whether it come in the form of lightning or of any other; but if there is no topical violence produced by this agent, the case is not quite so hopeless as in some of the others which occur less instantaneously; as the copious affusion of cold water, if applied instantly, sometimes makes the body re-act. Excessive exertion in man and other animals, and excessive mental excitement in man have the same results; and some of the more deadly poisons both animal and vegetable have still the same. The bodies of animals perishing by any of these, or any other means which prevents the stiffening of the muscles after death, become much sooner putrid than those which stiffen; and as the vessels lose their contractile power at the same time that the tone of the blood is broken down, the flesh of the animals, if it is to be used as food, cannot be so completely cleared of blood. It is on this account, as well as on that of the tendency to putrefaction, that the flesh of overdriven cattle is so very unwholesome.

The coincidence of so many causes operating upon so many different parts of the body, and in so varied ways, and yet all producing effects so simultaneous and so similar, in destroying the power of coagulation or of the formation of fibrin in the blood, and of contractility in the muscles, show beyond all doubt that there is a similarity, if not an absolute sameness, in those two parts of the animal system. The co-existence, or co-production, of contained blood and containing muscular vessels, in the very first stage of organisation in the young animal, is a farther confirmation of this; and when, as in this case, we find the physiological proof nearly complete, we may safely call in that of the chemical composition in which the fibrin of blood and muscular fibre completely agree.

The very same evidence, however, prevents us from concluding that the blood or the muscular fibre, or the union of the two is the immediate seat of life. Indeed, it leaves the question of life and its locality exactly where they were found—that is, as matters beyond the range of philosophical inquiry, and therefore without the pale of useful and legitimate speculation. A blow upon the stomach sufficient to cause death, or a concussion of the brain producing the same result, has more effect upon this peculiar quality, both of the blood and the muscle, which may be considered as their specific modification of life, than if the blood were wholly spilt upon the ground, and the muscles hacked by innumerable wounds. Indeed the wounding of the muscles tends to increase the contractile power of those which remain, and no wound of a muscle is, in the first instance, mortal, though it may become so by ulceration and gangrene, the putrid matter of which is taken into the system by absorption. Those who are killed by sword wounds die with the body in a state of great excitement; and the probability is that they feel much more pain than those who perish by gun-shot. The crimping of fish, by cutting the flakes of the muscles before life is extinct, and then applying a stimulant to the wounds, though withal a most barbarous operation, if people are to be supposed to feel for that on which they feed, shows that the contractility of the muscles even of a fish, in which what is called (not very intelligibly) *muscular irritation*, is understood to be much less sensible than in the warm blooded animals, is not very greatly destroyed even by a number of deeply incised wounds.

In the case of the blood again, the removal of a portion of that may be considered the severest mechanical injury which it can receive; and this instead of having any tendency to destroy either its supposed vitality, or its capacity of healthful action, is very often a means of restoring the blood to a healthy state in those cases where it may be said to be diseased, and of recovering the whole body in the case of many casualties and not a few diseases. In many cases where by stunning, contusion, or many other means, the action of life is suspended, that action can generally be restored if blood can be made to flow from an opened vein; and if the vital heat is not gone through length of time, or there has been something more than a mere mechanical injury without mortal wound, the impossibility of obtaining blood from a vein, is one of the most hopeless symptoms.

Though there is not much meaning in great part of which is said and written on the subject of diseased states of the blood, there are some diseases of which the character is indicated by the appearance which the coagulum of the blood assumes, when it is allowed to settle. One of those in which the blood has a very dark appearance, and comes from the veins as if it had already undergone a sort of imperfect or spurious coagulation in the system, and which is the result of an imperfect or diminished circulation bordering upon the putrid type, can be better explained in the article CIRCULATION, as in that article we propose to explain the action of respiration on the blood, as well as the mere motion of the blood in the vessels. But there is another case, that in which the coagulum exhibits what is technically called "the buffy coat," from its resemblance to buff leather. This is characteristic of inflammatory disease, in which the circulation is greatly increased both in rapidity and violence, and attended with much heat, showing that the system labours, or that there is much resistance to the increased motion of the fluid. This increased resistance does not take place so much in the larger vessels, as in the capillaries, by which the minute extremities of the arteries and veins are united to each other, and through which the circulating blood must pass. It falls not within the scope of natural history to examine the causes by which this resistance is produced; it may arise from stimulus of the propelling organs, or from a decayed state of the capillaries themselves, brought on by interrupted perspiration, and by many other causes. The buffy coat consists of matter analogous to pus, which is brought from the capillaries by the veins, and if continued to a certain extent it would change the character of the disease by the gradual accumulation of a poison in the system. The taking up of foreign matter by the veins, is not however the sole cause, or even always a cause of the appearance of this buffy coat. There may be a decomposition of the blood in this inflammatory state, by means of which the colouring matter (the red globules) which is rather an adjunct to the fibrin than a constituent part of it, falls to the bottom, and leaves the fibrin itself upon the surface; but in those cases there is very generally an admixture of matter resembling pus, and not unfrequently such matter predominates. The carrying of this matter, or of blood which in any way exhibits the buffy coat, to the lungs, on the walls of the cells of which the capillary ramifications of the vessels are peculiarly fine, is always attended with an aggravation of the disease, and if the lungs are weak, there is some danger of the disease being thrown upon them.

Many experiments have, since the improvement of pneumatic chemistry, been made with a view of ascertaining the action of different gases on the blood, but the performance of such experiments is rather a nice operation, and when they are performed, they are of no great value, because, in the living subject, gases do not come into contact with the naked blood. The place where any gas comes most nearly into contact with the blood of animals is in the breathing apparatus, whether lungs or gills, and the explanation of the action there is one part of what we propose to reserve till the article Circulation. We may, however, in the meantime, mention generally, that oxygen appears to retard the process of coagulation, but that it is accelerated by carbonic acid, and by all the gases generally which are unfit for the purpose of respiration; that the application of oxygen tends to heighten the scarlet colour of the blood, but that those gases which accelerate the process of coagulation tend to make the colour darker and blacker. The effect of oxygen may be seen in any case where blood is allowed to coagulate exposed to the atmosphere, for in such cases the upper, or exposed surface, is of a very intense and beautiful red, while that which is below, and with which the air does not come in contact, is of a more dingy hue. Whether, in this case, the oxygen of the air produces the same effect upon the blood as it does when applied through the coats of the pulmonary vessels in the process of respiration—that is, whether it attracts carbon from the blood, and forms carbonic acid with that carbon, is not exactly known, but there is a specific difference between the action of oxygen upon blood when out of the vessels and when in them. In both cases the colour of the blood is changed to a finer red by the action of the oxygen; but while that gas retards coagulation in blood exposed to the free air, it appears to accelerate the same operation in the vessels; for arterial blood coagulates sooner and more readily than the darker blood of the veins, although, when a coagulum once forms in the darker-coloured venous blood, it is of much firmer consistence.

Why the case should be different with blood exposed to the free air has not been very satisfactorily explained, but one can very readily see the advantage of the effect produced by oxygen upon the blood within the vessels. The more readily that the blood coagulates when taken out of the system, the more easily must it come to that state in which it forms into fibrin in the system; and the less completely that it passes into a solid coagulum, the greater may we suppose to be its susceptibility to vital action; for coagulation is the state of final and irreclaimable inertia in the blood, except in those cases of violent action in which the crassamentum is broken down, and the power either of forming fibrin or of coagulating prevented.

The red particles of the blood which, along with fibrin, or matter disposed to form fibrin, make up the whole volume of the crassamentum, or clot, have, as is the case with all natural substances, the use of which is not very well known, given rise to much speculation. According to what may be considered the most accurate measurement of these particles, they do not exceed the two-hundredth part of an inch in diameter, and therefore they fall under the denomination of objects wholly microscopic, the descriptions of which are always to be received with caution, as the refraction, and other colouring tendencies of the instrument, are apt to change both the apparent size and the apparent colour of that which is seen through it. There have been many differences of opinion about the size, the form, and the use of these particles, but none of them are very satisfactory, and they are too minute for enabling us to hope for any thing very conclusive. They are said to differ in magnitude and also in form, not only in different animals, but in the same animal during different stages of its development.

Though the use of these red particles in the animal economy is not known, and though no satisfactory inference can be drawn from the examination of bodies in themselves so minute, unconnected with the system and with each other, any farther than that they float in the blood, intimately and equally distributed through its mass in ordinary and healthy states, attaching themselves in the fibrin when it forms either into clot or into a fibrous consistency, and tending to precipitate in those inflammatory states of the blood in which it shows the buffy coat when drawn from a vein; yet they must answer some very important purpose connected with life and living action in those animals which have their organisation much developed. Little knowledge can be hoped to be obtained from an examination of their forms, or of their chemical composition as matter; for the investigation of living action, and the means by which that action is performed, is an investigation of connections, not of single parts—of relations, not of forms; and when they are in such a state as that we can obtain any, even the slightest knowledge of their chemical properties, they are out of their connection; the relation between life and them is at an end; they can be examined as dead matter only; and all the conclusions at which we are capable of arriving, relate only to the part which they are capable of performing in the economy of dead matter.

It has been said that these minute particles, or globules (for even their figure is not fully ascertained), consist of an external coat or tunic, a contained fluid, and a central nucleus. If such be the case (for even this is obscure), there is in them some resemblance in arrangement of parts to that which occurs in an egg; and as probably the majority of the eggs of animals are stimulated into action by external causes, we might perhaps conclude that those red particles of the blood form the portion of it which is most sensible to such causes, and which, easily excited in itself, extends excitement to the rest of the system. But the analogy, even if it were good for any thing, fails, because these particles are certainly not germs of any kind, and out of the system they resign themselves to that chemical decomposition to which all organic matter is subject when the life which it once exercised is at an end.

It were very desirable to know something about those red particles, because they are common to the blood of all vertebrated animals; because, as the blood is most abundant in the most perfectly developed races, they must be most numerous in them; because they contain an ingredient which does not appear to be formed in any other part of the system, at least in such abundance; and because they have a tendency to separate from the blood (at least partially) in cases of inflammatory disease; and above all, because it is in them chiefly that the effects of air in the grand operation of breathing are chiefly visible. These considerations bring us apparently so near to something like use in the globules, that one feels strongly tempted to leap the boundary, and declare and speculate about real use; but alas! there is "a gulf fixed," and that gulf is fathomless.

Even in the humble matter of a chemical analysis, these globules set our most careful operations at defiance. We can never be sure that we have separated them entirely from the other parts of the blood, and in those cases wherein this appears to have been most closely approximated, the greater part of the products obtained from their decomposition were found to be the same as those in the rest of the blood—only, about an eightieth part of their volume resisted the fire, and of that more than the half, and about one hundred and fiftieth part of the active mass, consisted of oxide of iron. When merely acted upon by saline mixtures, but not decomposed, these particles show much sensibility to chemical action. Some substances make them contract, some expand them, some brighten their colour, and some render them darker; but in every case these are the ultimate results, and we are unable to draw from them any other conclusion than that these bodies are very sensible to chemical action; but what are their relative degrees of sensibility when in the living circulation, and when out of it, we have no means of ascertaining.

It is usually understood, that too free a use of common culinary salt darkens not only the colour of the blood, but the complexion generally. Salt provisions have a tendency to produce scurvy, in which the blood is dark; and a darkening effect, with a tendency to the irritation of the smaller vessels, is produced by too free a use of stimulating liquors. But, any conclusion which we might fancy ourselves able to draw from these cases is met by others of a quite opposite kind, or at least, apparently arising from opposite causes. Exposure to cold, or any thing which gives great rigidity to the small vessels near the surface, produces an effect analogous to that of stimulating liquors; and too meagre food brings on scurvy as well as salt provisions. Besides, as we never can obtain any other than a systematic result when we make experiments on the living body, we are not able clearly to decide which is the part first and chiefly affected.

The most important part of the inquiry is certainly that which relates to the change of the blood in respiration, and the consequent differences between venous and arterial blood; and it is in the red particles that this change, or the difference which this change produces, is most apparent. Whence the excess of carbon with which the blood becomes loaded in its return from the systematic circulation, and which imparts to it its dark colour, comes, we are unable to ascertain. It may come in part from those portions of the body which the blood reaches, it may come from the substances which are taken up by the absorbents, or it may come from the alimentary chyle. It is indeed not improbable that it comes from all three; for the blood in the vein has assumed the dark colour at an early stage of its return; and the matters which the thoracic duct empties into the subclavian, whether products of digestion or of absorption, are not fit for the circulation until they have undergone the operation of the air in the breathing apparatus.

It is doubtful whether the red globules of the blood owe the whole of their colour to the presence of the iron; but the iron does at all events accompany the colouring matter rather than the other parts. It is in such quantity that there are computed to be about two ounces in the blood of an ordinary man in a healthy state. There is also a trace of iron, although a fainter trace, in red muscle; and the redder the muscle, the trace of iron is the more apparent. It does not appear to exist, at least in such quantity as to be detectible by any of the common chemical means, in those parts of the body which are not reddish, or in those animals which have not red blood; but these facts are not conclusive evidences against its existing there in a very minute quantity.

The red particles of the blood and the muscles are the parts of the animal most easily excited; and we have already seen that the crassamentum, or cruor, of the blood, including both the part which can be converted into fibrin and the red particles which accompany that in the blood, and the fibrin which is developed in the muscles and appears to derive its colour from that of the blood, are excited in the same way by very different causes. From these coincidences, it is very difficult to refrain from speculating about the rationale of muscular action. We do not mean as to whether it is mechanical or chemical; because, although as being displayed in and by matter which still retains its properties as matter, though subdued or suspended while that matter forms part of the living animal, it must be both mechanical and chemical in its relations, yet in itself and primary it is neither; it is physiological not physical—using the first of these terms as descriptive of the phenomena of organisation, and the second as descriptive of the phenomena of matter when not organised.

Still, this, which we may properly regard as the primary action of animals, that to which all their other actions are owing, and in the suspension of which all these are suspended, must be regarded as material—that is as a result of matter and not of mind. Mind has no mechanical action. Knowledge is its province, but it cannot of itself stir one atom of matter a single hairbreadth. Hence in man the organisation and the life of the animal are as necessary and perfect for mechanical purposes as the thought is for mental ones; and thus far man is as subject to death and material dissolution as any other creature, and in all the states and functions of his material frame he follows the same law as the rest. It were in vain, therefore, to seek for an explanation of animal action as a result of any thing like mind; because mind could not accomplish it without having the properties of matter, that is, without being matter. When, therefore, we speak of "animal spirits" as being the cause of activity, we only encumber ourselves with additional words without any additional meaning; and in the individual case, the words should be reversed, and that which we call animal spirits should be called a "spirited animal," the word spirit in that case having reference to the energy or manner of the action, not to its cause.

But if this primary action of the animal be, as it unquestionably is, a phenomenon or property of matter only, with what other portion of the material creation shall we connect it, or where else shall we find its counterpart? Where too shall we look for its origin? for unless we go back to the moment of creation, we must have a natural cause for every natural effect—a natural antecedent for every natural consequent; otherwise, we stand in need of creation and miracle every day; by which means the original creation becomes no creation at all; and if so, then there can be no miracle, and no daily creation; and the whole becomes an absurdity. Such is the conclusion to which all the sceptical doctrines lead, if we carry them but a single step beyond the doubting point—that point at which the mind loses the way and will not seek direction in that quarter where alone it is to be found. Yet it is not accurately called the doubting point, it is really the point of too easy belief—that at which our vanity turns away from the truth, and gives full and doting credence to the absurdity.

This animal action, which we find most remarkably displayed in the blood and the muscle, is then a phenomenon of matter, and of matter only; and as such every case of it must have an antecedent or a cause, not merely a cause to put it in motion at the time or for the instant, but a cause to which its capacity or faculty of being put in motion must be owing. Is it of the parent, descending from generation to generation? It is not. The parent does not in any instance communicate motion or action of any kind to the offspring. Even in the case of uterine production, in which, from position and some other circumstances, might be led to believe that there is the closest connexion, there is no transmission of animal action from the mother to the young. There is a partition, and there are two distinct lives. All the organisation on the one side, whether for that particular state, or for more permanence, is of and from the life of the parent; and all on the other side is of and from the life of the offspring. There is no community of circulation, no community of muscular action, no community of nervous affection, and no community in any one particular that can be named. Either may be indisposed while the other is in health, and either may die the other remaining alive. The young may be cast off as an untimely thing, or it may turn to corruption *in situ*, and yet the parent may escape. And if no casualty happens, it separates in the fulness of time; and unless in those membranes which were its own, that is, the products of its own organisation, there is no wound nor laceration. The parting is one of health, and the final step of a healing process, just as the seed falls off when it is fully ripe, or the leaf when the seasonal action of the tree is at an end; or more appropriately, the egg of the oviparous animal, which is actually dissolved from all connexion with the parent, and elaborating its own structure, by a curious preliminary action of life, before it comes to be deposited in the external nest.

Thus, even in this the most wonderful portion of nature, or of science of any kind, in which the mind can be occupied, we seek in vain for the origin of the living action—that which is in the blood and the muscle, and which the stroke of the lightning, and the other causes to which allusion has been made, can destroy in an instant. In the succession of races, we find that there is a continuation of matter, but no continuation of that motion which we consider, and rightly consider, as the indication of life. That may be, and is, within certain limits, similar in the species through all its generations; but in every individual it is new, the life of that individual and of none else. And here we can see clearly that it is mortal life, that as it begins with the individual, so with the individual it ends. Not one tittle of the experience of the material parent descends to the material offspring, but as life begins *ab origine* in the individual, so does all the experience of life. Not so with mind: there the memorial remains, and in the simple fact that we of the present generation may be wise in the wisdom of generations gone by, we have a proof and at the same time an illustrative example of the immortality of mind, and of its entire difference from matter.

Where, then, is that action of life in the animal which belongs to it as matter, and begins and perishes with the individual? Is it of the organisation? No; for it is by this very action that the organisation is evolved. Is it true that we cannot pronounce that there is life till we can see its effects; and as the first action of life in many animals is the evolution of its own structure, we cannot pronounce that there is life till some rudimental part of that organisation is formed; we cannot, for instance, say that the egg is not addled, and as such only a portion of matter fit for going to the store-house of nature's materials, till we see the primary action in it—the presence of the rudimental heart and the rudimental blood, the former a muscular structure, and the latter capable of elaborating that peculiar kind of muscular substance. These are the first evidences which we can obtain; but they are not the beginning; they are the results,—and results of self-action in the egg, though that action requires certain external stimuli—certain other actions of matter before it begins.

Thus the action precedes the organised substance; and therefore the action must be analogous to something which is not cognisable by the ordinary tests of matter. And when we look around, we find that this is not the only case in which results are brought about by means which cannot be brought to our ordinary tests of matter. The action of heat is all-powerful, so much so, that no strength of matter can withstand it; and yet it counts as nothing by the balance, and measures not a hair-breadth by the line. Light is in the same predicament; and when a certain intensity is arrived at, light and heat are inseparable. Electricity, by mechanical friction, or by chemical decomposition, and magnetism, apparently dependent upon the relative positions of one substance with another, are also, at certain degrees of intensity, inseparable from heat and light. There is, therefore, an obvious connexion between all these phenomena, or all these actions—for we cannot consider them as matter or substance under any modification—as no intensity of any or all of them can be made to amount to a material quantity. We see their effects only in some kinds or combinations of matter; and in different kinds or combinations, or in the same under different states; but they differ in their apparent intensities. Our natural perceptions are limited to that which it is necessary for us to know; and as we extend the bounds of our knowledge, the means of extending that knowledge further and making it more minute, extend along with them. The same science which sought to explore the heavens, found out the telescope, and the desire of being better acquainted with the minute, led to the construction of the microscope; therefore we need not despair in any matter which lies within the scope of the material creation. Those energies, which we have hitherto been able to observe in particular substances, and under particular circumstances only, may be afterwards found to influence all substances under all circumstances; and, among others, the living body in all its states. They, including animal life in the number, are probably all modifications of one energy; but we must not pursue the subject further. See LIFE.

BLOOD FLOWER. The *Hæmanthus coccineus* of Linnæus. A splendid family of bulbous plants, natives of Africa. They belong to *Hexandria Monogynia* of the sexual system, and to the order *Amaryllideæ* of Jussieu. Generic character: spatha consists of from four to six valves, containing many flowers, and persisting; corolla tubular below, limb six-parted, regular, erect; stamens springing from the tube of the corolla, protruding; filaments awl-shaped, anthers incumbent; style simple; berry three-celled, seeds trigonal. Like all the lily tribe this genus is most showy; and if a single flower enriches our assemblages of plants, how much more magnificent must acres of them appear in their native place! Amid the burning sands of Sierra Leone they appear in all their glory; the desert is cheered by the brilliant patches of the blood-flower, seen profusely scattered around; and though in the dry season the vitality of almost all herbaceous vegetation suffers, yet that of the *Hæmanthus* is safe,—secure in its investment of thick abbreviated leaves, which guard the living principle.

BLOODWORT is the *Sanguinaria Canadensis* of Linnæus. This plant is also called *Pucoon.*

BLOW-FLY (*Musca* [*Sarcophaga*] *carnaria*, Linnæus). A species of dipterous insect, belonging to the family *Muscidæ*, exceedingly troublesome in summer, in consequence of its incessant endeavours to deposit its offspring upon our animal food. It is of a black colour, with four longitudinal grey lines on the thorax; the abdomen is chequered with black and grey, and the legs are black. It is as large as, but more slender than the bluebottle-fly. These insects are of great service in the economy of nature, their province being the consumption of dead and decaying animal matter; and in order that the most effectual measures may be taken for the performance of this duty, nature has endowed them with the singular power of hatching their young in their own bodies, so that no time is lost by the insects remaining in the egg-state when deposited upon the decaying carcase. These insects have consequently been termed viviparous; but Messrs. Kirby and Spence object to this term, since none of these embryos are nourished, as in the true viviparous animals, within a uterus, by means of a placenta, but receive their development within true eggs, which are hatched in the body of the mother. This is confirmed by the observations of Degrer, who discovered eggs in the body of this fly. The numberless minute larvæ contained in the abdomen of the blow-fly are arranged in a remarkable manner; being of an oblong form, they are placed in an upright situation, side by side, against each other, and are coiled up in such position, somewhat resembling a roll of riband, which, when unfolded, was discovered by Reaumur to be nearly two inches and a half long, although the body of the parent is scarcely one-tenth of that size. Each of these larvæ has a distinct envelope, of the finest membrane, which, however, is not entirely divided from that of those adjoining to it, but appears to be one tube, which becomes extremely slender between each individual, so as, when drawn out, to look like a chain. In another species of *musca*, which Reaumur observed to be similarly ovo-viviparous, the young larvæ were found to be heaped together without any other order than that of being longitudinally laid side by side.

But it is not alone in the production of living offspring that these insects are so admirably fitted for the performance of the functions assigned to them. It was asserted by Linnæus, that three flesh flies would consume a dead horse as quickly as a lion. This, however, must be understood as having reference to the offspring of such three flies; and as a proof of such assertion, it has been ascertained, that a single female of the *Musca carnaria* will give birth to 20,000 young, which must, of course, be gradually developed, as they will necessarily occupy several days in being deposited by the parent. Each of these grubs, in twenty-four hours, will, in consequence of its intense voracity, have increased in weight not less than two hundred times, and in five days they acquire their full size. It requires about the same period to undergo the pupa state, so that, in a fortnight's time, there are descendants of the first brood in existence. When ready to appear in the perfect state, and to quit the shell-like cocoon in which they have passed the pupa state, the enclosed flies bursting forth at one of the extremities of their case. This is effected by the dilatation of the leather-like front of the head, which is alternately pushed forward and withdrawn, and by the swelling out of the cheeks; by this means a small circular cap, which appears in this group of insects to be especially employed for this purpose, is detached, producing an aperture sufficiently large for the escape of the fly, which at this time exhibits as it were only the rudiments of wings, these organs being twisted up in several crumple-like folds, but which, in the space of a very few minutes, are gradually stretched out, when the fly appears in its perfect form, and is ready to assume all the energies of its species.

BLUE-BIRD, or BLUE-ROBIN (*Sialia*, Swainson). An American genus of small dentirostral birds, allied to the robins and chats of the old continent, but sufficiently distinct from these to form a separate and natural division. The form is rather similar to that of a robin, but somewhat more slender; the bill is of a stouter make, the wings are longer, and more fitted for protracted flight, and the tarsi are considerably shorter; the whole form, indeed, indicating more arboreal habits than those of their nearest analogues in the old world, and it does not appear, from the minute descriptions of various observers, that they find their food so much on the ground; although, like the robin of this country, they are sure to be seen hopping fearlessly about wherever ground has been turned up. Three species only are known at present, and these are showy birds, remarkable for the rich sky or ultramarine blue of the uppe parts, and which forms the predominant tint of their plumage. Their bills and feet are always black.

These birds belong to a highly natural and tolerably well defined group or division of the *Sylviadæ*, or warbler family, and which various writers have designated by the term *Saxicolinæ*, from the wheat-ear genus, *Saxicola*, considered the standard of the division. It contains also the robin, chat, fantail, and redstart genera, with several other forms from different parts of the globe, amongst which may be reckoned an interesting genus in New Holland (*Petroica*), performing in that country the office of the redstarts and robins of Europe and Asia, the chats of Africa, and the blue-robins of North America.

All these various birds have a considerable resemblance in their appearance, in their actions, and general character. Their forms are thick and short, and most of the species stand high upon the legs, and are well adapted either for perching, or for light and agile movements on the ground; which latter are mostly performed by hopping, though a few of the species (as the chats of this country) can also creep rapidly forward with alternate steps: yet this is not their usual manner of progress, and is only resorted to when they are frightened, or when a cloud passes over the sun, as they run to a place of shelter, with their under parts almost touching the ground: a single genus, however, the fantails (see *blue-breast*), use only the walking, or rather running mode of progression. The plumage of these birds is generally very dense and thick, with two or more colours, seldom brilliant, but often rich and sometimes boldly contrasted; and many of the species have terminal winter edgings to their feathers, which gradually disappear in spring: the nestling, or first plumage, is invariably more or less mottled, or spotted with a lighter colour on the upper parts, and slightly edged with black on the under; a circumstance peculiar among the sylviadæ to this division, and reminding us of the flycatchers and thrushes, to each of which families certain of the species present various approximations, both in structure and habits. The tail is usually capable of much motion, but chiefly of being flirted up and down, is never long, and in many of the species (as the wheatears, chats, and blue-breast) is rather short, but in these is very capable of expansion. Their flights are usually confined to short distances (though many species migrate), and their manner of flying is somewhat peculiar, as they commonly drop from their perch to within a few inches of the ground, proceed close to the surface, and then mount often for several feet to alight; settling generally on the topmost twig of a tree or bush, or on the very summit of a hillock, or building, whence, possessing great power of vision, they can espy a beetle or other insect crawling among the grass at a very considerable distance, as Wilson (the American ornithologist) observes of the blue-robins, the subject of the present article. All the species have this habit of usually perching on the very highest point of an object, and many of the more typical chiefly inhabit open downs and commons, and even mountainous districts, where, perched on a slight eminence, their vision can command a considerable extent of surface. They are mostly very solitary birds, or seen only in pairs, the majority of them never associating in flocks, though the abundance of certain species in particular situations would lead to the supposition that they were social; the American blue-robins, indeed, appear to form the only exception, and these certainly migrate in society; but many sorts of birds collect in flocks to perform their seasonal migrations, the habits of which (as those of the blue-robins) are solitary at other times; but the European robin, chats, and redstarts, even cross the ocean in solitude, as the writer of this article has remarked in every instance which has come to his knowledge of these birds alighting on the rigging of ships . indeed, so little are they inclined to be social, that if two robins happen to alight on the same vessel, hostilities between them are always soon commenced, one usually takes possession of the bows, and the other of the stern, and they fight on the least invasion of each other's territory. The common redstart is equally pugnacious; and a flock of either of these birds would be as much a phenomenon as one of mountain eagles.

The food of the *Saxicolinæ* consists of earthworms, and various insects, which are chiefly sought for on the ground; and, like the nightingales (to which some of them are nearly allied), they appear most fond of the larvæ of beetles, in search of which the redstarts often enter the hollows of decayed trees, and examine the rotten wood; these latter, also, together with the blue-breast, and the Australian *Petroicæ*, capture insects on the wing like the flycatchers, and may often be seen hovering around a bunch of leaves, examining them for caterpillars and spiders. Others, as the robins, chats, and especially the American blue-robins, feed occasionally on various small fruits and berries, which are swallowed whole. They have all the power of hovering in the air, and many of them often sing while on the wing, the wheatears whilst hovering, and the redstarts as they fly from tree to tree. Even their very notes are, to a certain extent, extremely similar; and their songs are always uttered in short detached staves, like those of the thrushes, and never (as in the skylark, or the blackcap, and various other warblers) in a continuous unbroken strain. Their nests (which are of loose construction, though containing much material) are never situate on a forked branch, nor fixed among the twigs of a bush, but rest always on a solid and substantial basis, either (according to the genus) in the hole of a tree, the nook of a rock or building, or on the ground, under cover of a stone or clod of earth, or of thick herbage. The eggs vary from four to seven, and, in every known instance except the robin, are of a uniform blue or bluish white, and mostly spotless.

Upon the whole, this is a very natural and tolerably well marked group, although, as in every other numerous division, it is difficult to draw a single general character to which some few of the species do not offer an exception. It is a group, however, very easily recognised by all who pay attention to birds. The chief distinctive characters of the blue-robins have already been mentioned; they are formed more for flight, and for perching, than for seeking their food upon the ground; and their bills are of a stouter and stronger make than those of most of the other birds of this division. Accordingly, we find, in Wilson's admirable account of the common species of the United States,

SIALIA WILSONII (*Sylvia sialis*, Latham). He states, that "their principal food are insects, particularly *large beetles*, and others of the coleopterous kinds that lurk among old, dead, and decaying trees. Spiders are also a favourite repast with them. In the fall, they occasionally regale themselves on the berries of the sour gum; and, as winter approaches, on those of the red cedar, and on the fruit of a rough hairy vine that runs up and cleaves fast to the trunks of trees. Ripe persimmon is another of their favourite dishes, and many other fruits and seeds." This species is six inches and three-quarters in length, with the wings remarkably full and broad; the whole upper parts are of a rich sky-blue, with purple reflections; the bill and legs black; inside of the mouth, and soles of the feet, yellow; the shafts of all the wing and tail-feathers are black; throat, neck, breast, and sides, reddish chestnut; wings, dusky black at the tip; belly and vent, white. The female is easily distinguishable by the duller cast of the back, the plumage of which is skirted with light brown, and by the red on the breast being much fainter, and not descending nearly so low as in the male; the young are brownish on the upper parts, and not very much mottled. A curious fact has been noticed by the honourable and Rev. W. Herbert, of the plumage of this species; we believe, in individuals kept by him in confinement, in this country, he says "the American blue-bird produces brown feathers in its summer moult, which are very suddenly turned to blue." It is most probable that this change also takes place in a state of nature, though the fact has not hitherto been noticed by those who have described the bird.

This species is found over the whole United States; as also in the Bahama islands, where many of them winter; and in Mexico, Brazil, and Guiana; though probably another and closely allied species, the *S. Mexicana*, has often been confounded with it in these latter countries.

The third species, *Sialia arctica*, inhabits the far countries, and was discovered by the naturalists who accompanied the last overland expedition. This also is a beautiful bird; the upper parts are rich ultramarine blue, and the under parts greenish blue, inclining on the abdomen to greyish; the vent-feathers, and under tail-coverts, white. The bill is narrower at the base, but larger and more strongly formed than that of *S. Wilsonii*, which species the bird much resembles in size and general appearance.

In describing the common species of the United States (*S. Wilsonii*), Wilson eloquently observes, that "the pleasing manners and sociable disposition of this little bird, entitle him to particular notice. As one of the first messengers of spring, bringing the charming tidings to our very doors, he bears his own recommendation always along with him, and meets with a hearty welcome from every body.

"Though generally accounted a bird of passage, yet, so early as in the middle of February, if the weather be open, he usually makes his appearance about his old haunts, the barn, orchard, and fence posts. Storms and deep snows sometimes succeeding, he disappears for a time; but about the middle of March is again seen, accompanied by his mate, visiting the box in the garden, or the hole in the old apple tree, the cradle of some generations of his ancestors. 'When he first begins his amours,' says a curious and correct observer*, 'it is pleasing to behold his courtship, his solicitude to please and to secure the favour of his beloved female. He uses the tenderest expressions, sits close by her, caresses and sings to her his most endearing warblings. When seated together, if he espies an insect delicious to her taste, he takes it up, flies with it to her, spreads his wing over her, and puts it in her mouth.' If a rival makes his appearance,—for they are ardent in their loves,—he quits her in a moment, attacks and pursues the intruder as he shifts from place to place, in tones that bespeak the jealousy of his affection, conducts him with many reproofs beyond the extremities of his territory, and returns to warble out his transports of triumph beside his beloved mate. The preliminaries being thus settled, and the spot fixed on, they begin to clear out the old nest, and the rubbish of the former year, and to prepare for the reception of their future offspring. Soon after this, another sociable little pilgrim, the house wren, *Troglodytes Œdon*, also arrives from the south, and finding such a snug berth preoccupied, shows his spite by watching a convenient opportunity, and, in the absence of the owner, popping in and pulling out sticks; but takes special care to make off as fast as possible.

"The female lays five, and sometimes six eggs, of a pale blue colour, and raises two, and sometimes three broods in a season; the male taking the youngest under his particular care while the female is again sitting * * * *. Their spring and summer song is a soft, agreeable, and oft-repeated warble, uttered with open quivering wings, and is extremely pleasing. In his motions and general character, he has a great resemblance to the robin-redbreast of Britain; and, had he the brown olive of that bird, instead of his own blue, could scarcely be distinguished from him. Like him, he is known to almost every child; and shows as much confidence in man by associating with him in summer, as the other by his familiarity in winter. He is also of a mild and peaceful disposition, seldom fighting or quarrelling with other birds. His society is courted by the inhabitants of the country, and few farmers neglect to provide for him, in some suitable situation, a snug little summer-house, ready fitted and rent free. For this he more than sufficiently repays them by the cheerfulness of his song, and the multitude of injurious insects which he daily destroys. Towards fall, that is, in the month of October, his song changes to a single plaintive note, as he passes over the yellow many coloured woods; and its melancholy air recalls to our minds the approaching decay of the face of nature. Even after the trees are stripped of their leaves, he still lingers over his native fields, as if loth to leave them. About the middle of November, few or none of them are seen; but, with every return of mild and open weather, we hear his plaintive note amidst the fields, or in the air, seeming to deplore the devastation of winter. Indeed, he appears scarcely ever totally to forsake us, but to follow fair weather through all its journeyings till the return of spring.

* * * "The blue-bird, in summer and fall, is fond of frequenting open pasture fields; and there perching on the stalks of the great mullein, to look out for passing insects. A whole family of them are often seen thus situated, as if receiving lessons of dexterity from their more expert parents, who can espy a beetle crawling among the grass at a considerable distance; and, after feeding on it, instantly resume their former position."

We see, in this last passage (as Sir W. Jardine observes, in his note to Wilson), the exact habits of the European chats portrayed. "They invariably select the summit of some elevation, a hillock, a stone, bush, or some of the taller wild plants, and if occasionally on a tree, the topmost branch is always preferred; there they perch, uttering their monotonous call, which increases in anxiety and frequency as we approach the nest, or the young before they are able to fly; or they alight at intervals, run" (or rather hop about like a robin) "for some distance, and again remount to a fresh station. When not annoyed, they retain the same elevated situations, looking out for food, taking the insects seldom on the wing, but generally by a sudden spring, or by leaping down, and returning immediately with the prey in their bill, where it is retained for a few minutes, while they repeat their uniform note. The young, as soon as

* Mr. W. Bartram, the venerable friend of Wilson.

they are able to fly, have the same manners with their parents, and at the season when these are first on the wing, some extensive commons have appeared almost entirely in motion with our common species*."

Speaking of the migration of the blue-birds, Wilson observes, that "nothing is more common in Pennsylvania than to see large flocks of these birds, in spring and fall, passing at considerable heights in the air; from the south in the former, and from the north in the latter season. I have seen, in the month of October, about an hour after sunrise, ten or fifteen of them descend from a great height, and settle on the top of a tall detached tree, appearing from their silence and sedateness, to be strangers, and fatigued. After a pause of a few minutes, they began to dress and arrange their plumage, and continued so employed for ten or fifteen minutes more; then, on a few warning notes being given, perhaps by the leader of the party, the whole remounted to a vast height, steering in a direct line for the south-west. In passing along the chain of the Bahamas towards the West Indies, no great difficulty can occur, from the frequency of these islands; nor even to the Bermudas, which are said to be six hundred miles from the nearest continent. This may seem an extraordinary flight for so small a bird; but it is, nevertheless, a fact that it is performed. If we suppose the blue-bird in this case to fly only at the rate of a mile per minute, which is less than I have actually ascertained him to do over land, ten or eleven hours would be sufficient to accomplish the journey; besides the chances he would have of resting by the way, from the number of vessels that generally navigate those seas. In like manner, two days at most, allowing for numerous stages for rest, would conduct him from the remotest regions of Mexico to any part of the United States." Many blue-robins, however, it would appear, never leave the United States' territory, a few solitary individuals being seen there even in the depths of winter, especially about the cedar trees, whence they issue and approach the cultivated grounds at every interval of fine weather.

The blue-robins are interesting birds, not only from their pleasing familiarity, but from their general distribution and number of the individuals in North America, where they are the only *Saxicolinæ*, and where they consequently appear to occupy the station, and to perform the office, which in other parts of the world, are filled by a considerable number of birds, of various species, and even genera. They are birds which follow cultivation, and have doubtless greatly increased in numbers since the country was reclaimed by Europeans, and will still continue to increase, as the forests are cut down, and their sites become adapted to their habits.

BLUE-BOTTLE, or FLESH-FLY. The *Musca vomitoria*, Linnæus, and several other allied species of dipterous insects, are ordinarily known under this name. They are amongst the largest species of the genus found in this country, and generally of a blue colour, whence their name; some species, however, with similar habits, are green, as the *Musca Cæsar*. In their habits, however, they very nearly resemble the blow-fly, but with this principal difference, namely, that they are deposited in the form of eggs by the parent flies. But here, again, we find nature equally rich in resources, since the eggs, instead of lying for days or weeks in an unhatched state, as is generally the case with insect eggs, are hatched in the course of a couple of hours. The insatiable voracity of the grubs hatched from these eggs is not less than that of the blow-fly. Of this Messrs. Kirby and Spence have given a remarkable instance, in which these flies attacked the living body of a poor man who incautiously laid himself down in a field, having been taken rather unwell, the flies being, in the first instance, attracted by pieces of meat which he had begged and placed between his shirt and his skin; and to such a degree did the grubs swarm upon his body, eating into it in all directions, that he only survived the operation of cleansing his body from them for a few hours. A recent writer has attempted to call in question the unerring instinct of insects in the deposition of their eggs upon those substances most congenial for the food of the young when hatched, and has instanced, in support of his attempts, the case of the common blow-fly, *Musca vomitoria* (or rather *M. carnaria*), which sometimes lays its eggs in the fœtid funguses (*phalli, agarici*, &c.), "apparently under the notion that these are genuine carrion."—Insect Transformations, p. 76. We apprehend, however, that the only notion entertained by the insect is, that the substance upon which the eggs are deposited will serve for food for its young, which it does most effectually. Thus this mistaken "notion" tells against the writer's argument. We have seen the carrion plants, *Hoya carnosa*, swarming with grubs, which there obtain an abundant supply of food, as figured by Rosel (*Muscidum et Culicum*, plate 9, 10.) From the experiments of Spallanzani, it appears that these grubs are able to withstand a heat of 88° Fahrenheit, but that they perished when it was raised to 108°. These experiments were conducted with so much care, that we cannot hesitate in considering Dr. Good's statement, that eggs of the blow-fly deposited upon meat, and broiled with it upon a gridiron in a heat far beyond 212°, instead of being destroyed, are thereby quickened into their larvæ state. The appearance of maggots on broiled meat, as judiciously observed in the work above referred to, p. 119, from which the inference is apparently made, seems rather to indicate that eggs, or more probably ovo-viviparous larvæ, had been deposited there, not before, but after the broiling.

BLUE BREAST; SWEDISH, or BLUE BREASTED FANTAIL. (*Pandicilla Suecica; Motacilla Suecica* of Linnæus.) A small European bird, which lately has been added to the list of stragglers to the British islands, a specimen having been killed in an undoubted wild state, upon a common, near Newcastle upon Tyne. In size and form it much resembles the different redstarts (*Phœnicura*, Swammerdam), but differs from them in several minor particulars, and especially in its mode of progression, which is always ambulatory, or by alternate steps, and never by successive hops, as in those birds. The crown of the head and rest of the upper parts are brown, the latter tinged with greyish, and paler on the margins of the scapulars and wing-coverts; feathers at the base of the bill, and streak over the eye, yellowish white. The chin, throat, and upper part of the breast, rich azure, with a silky white spot in the centre; the blue bordered beneath with a narrow gorget of black, which is succeeded by another of reddish brown. Under parts dirty white, inclining to

* Note to Jardine's Edition of Wilson. Vol. i. p. 60, 61.

grey. The two middle tail-feathers brown, the remainder having their basal half of a bright ferruginous, or brownish orange colour. In the female the upper parts are paler, the chin pale azure blue, mixed with black, streak on each side of the neck, and upper part of the breast, black, intermixed with azure blue, and surrounding a large spot of white. The young are in their first plumage mottled.

This is a handsome and rather interesting bird, somewhat intermediate in character between the redstart, and the pipit and wagtail group; and also having some affinity for the fan-tail flycatchers of America (genus *Setophaga*, Swammerdam), from which it chiefly differs in the make of the bill.

It is a restless, active species, but its habits are very retired and shy; and as it runs upon the ground, or along the branch of a tree, it very frequently spreads its tail open wide, a habit in accordance with the transatlantic birds above-mentioned, the more characteristic species of which (as the *S. ruticilla*), have the tail exactly similar in form and colour. Like those birds, also, and the redstarts of the old continent, the blue-breast often captures insects on the wing, darting after them like the various species of flycatcher.

It is a migratory bird, chiefly inhabiting in summer the more northern countries of Europe, being rare in Germany, France, and Holland. Its haunts are in the forests, where, like the redstarts, it is said to build in the holes of decayed trees and to lay five or six eggs of a pea-green colour. Its notes are, we believe, very simple; and we are unaware of its possessing any proper song. Its food consists of insects and their larvæ, and earth-worms; and in confinement it soon becomes familiar, and is tolerably hardy, much more so than the different *Phœnicuræ*. With these last birds it has been very generally classed, but as we are sure such an arrangement would never be followed by those who have ever seen it alive, we have thought it best to make it here constitute a separate division; considering that, in the feathered creation especially, the associating in the same minimum group species which are not very closely similar, tends, in some measure to retard, rather than to advance, the progress of the science, the habits and manners of little known species being commonly and very naturally inferred, from a knowledge of those of the other species with which they have been grouped: nor is this remark altogether confined to such as are little known; the peculiarities of the bearded reed-bird (*Calamophilus biarmicus*) have been overlooked by most writers who have described it; and this merely, perhaps, because having been placed by Linnæus and most subsequent writers in the genus *Parus*, it has been commonly taken for granted that its general characters were similar to those of the other tits; and the same applies also to the bottletit, or long-tailed titmouse (see BOTTLETIT), a species very common in the British islands. So long, therefore, as the Swedish fan-tail continues classed in *Phœnicura*, its general characters will be presumed to be similar to those of the other redstarts, which latter, if kept only within due restrictions, form an extremely natural and well marked division. On this account, we have affixed the generic name *Pandicilla* to this species, a term expressive of its almost constant habit of horizontally spreading open the tail.

The fan-tail, or blue-breast, as we have already remarked, becomes soon confiding and familiar in captivity; and after moulting in the cage, the blue colour on the breast is always much duller than in the wild birds. These feathers are in winter fringed with whitish tips, which gradually wear off in the spring. In this country, it can only be considered as a very rare straggler, the above-mentioned being the only recorded instance of its occurrence; yet it is not improbable that some may be often compelled by adverse winds to take shelter on the British shores, when attempting to cross from the southernmost point of Norway: the disappearance of birds of passage in the autumn being, in many species, extremely gradual, and often continuing for a number of successive weeks.

BLUE-CAP, BLUE TITMOUSE, or TOMTIT (*Parus cœruleus*). This common little bird would be greatly admired for its beauty, were it only a little less abundant, its plumage when clean being a most delicate admixture of soft and pleasing colours. The forehead, a large triangular patch on each side of the neck, and a line over the eye, which is continued round the back of the head, white. A line of blackish blue commences on each side of the base of the bill, passes through the eyes immediately under the white band, and also meets behind, then descending and forming a broad band, surrounds the triangular patch of white, meets in front, and is continued up to the chin; imparting a sort of harnessed appearance to the bird. Under this, on the lower part of the back of the neck, is another broad spot of white. Crown of the head, wings, and tail, pale blue; the scapulars and greater wing-coverts tipped with white, the latter forming a white band across the wing. The back of a light greyish green, and the whole under parts sulphur yellow, with an ill defined blackish line along the middle of the belly, legs and toes bluish grey. The female differs only in being rather less bright in colour, and in the young the crown of the head is blackish brown.

In this titmouse the bill is shorter and thicker than in the more characteristic species of *Parus*, and the bird consequently exhibits some slight modification of habit. It is very rarely seen to hammer seeds in the manner of the others, nor does it often hold its food with both feet like the rest, but most commonly with one foot. In confinement, the others will entirely subsist on hempseed, which they hold firm between both feet, whilst they pierce a small hole in the husk with repeated knocks of the bill, through which they extract the kernel; but we have never observed the blue tit to hammer seeds in this manner, and though fond of hempseed, it will not, at least in confinement, ever touch it unless it finds some already cracked. The minutest characteristics are, in natural history, often quite worthy of attention, as they sometimes throw considerable light on the habits of an animal.

As restricted to the different species which nidificate in holes, the genus *Parus* forms an extremely natural and well marked division, the more characteristic species of which exhibit a marked resemblance to the jays (genus *Garrulus*) in very many particulars. Their general form and structure, and the loose, pretty texture of their plumage (the webs of the feathers being discomposed), their soft and subdued colours, their omnivorous appetites and hardy constitution, together with their general manners, their harsh chattering notes of alarm, the remarkable degree of cunning and sagacity which they evince, and their habit of constantly placing the foot upon their food whilst picking it to pieces, and of concealing for a future occasion what they cannot eat, all strongly remind us of the jays and magpies, and together confer a peculiar interest on this diminutive but pleasing group. The present species, perhaps, feeds less on oleaginous seeds than some of the others, but it may nevertheless be well termed omnivorous; it subsists in the spring and summer chiefly on insect food, to obtain which, in winter, it often pulls off the buds of trees, whence it has generally by horticulturists been considered an enemy; but we think inconsiderately, for, as is well observed by an eminent naturalist, Mr. Selby, "the trifling injury sometimes committed by the abrasion of a few blossom-buds, is more than compensated by the destruction of innumerable larvæ, and eggs of the insect tribe, which are usually deposited in or about those essential parts of fructification; and which, if allowed to proceed through the necessary changes, would effectually check all hope of produce." Moreover, we are inclined very much to question whether they ever do attack any buds but those on which they perceive the traces of an insect; for we have frequently observed them, when searching for their food upon the fruit trees, to pass by in succession many whole spurs full of blossom-buds, and then to attack eagerly a particular one, on which they no doubt perceive evident indications of the destroyer lurking within.

The blue titmouse feeds also on various kinds of fruit; and at the approach of winter will eat many farinaceous seeds, and even swallow corn whole; being particularly fond of oats, the husks of which it will sometimes hold fast between both feet in the usual manner of the genus, whilst it picks out the grain. It becomes very bold as the season advances, and frequents out-houses, and dust bins, and butchers' shambles, carrying off pieces of suet, picking bones, and eating all manner of garbage, and still searching every chink and cranny for the grubs of insects. It is a constant attendant wherever horse-flesh is kept for the hounds; and sometimes even evinces a sanguinary propensity, by attacking other small birds, when it finds them incapable of resistance, and after having killed them by repeated blows on the skull, devouring their flesh. We have noticed this likewise in other species of *Parus*, but nevertheless consider it to be of very rare occurrence, not one individual in fifty, perhaps, ever displaying any hostile feeling towards other birds.

The nest is generally situate in the holes of trees, or old walls, the former of which it often enlarges, and sometimes almost wholly excavates for itself, if the wood is soft and decayed. It is composed of various mosses, and lined with feathers and hair; and the eggs, six or eight in number, are white, speckled with rust-colour at the larger end. The female is not easily driven from her nest, but if an attempt be made to seize her, bites with severity, at the same time ruffling her feathers, hissing and making the spitting noise of an irritated kitten.

The notes of this species are few and little varied, consisting chiefly of a weak chirp, and a louder harsh chatter, its cry of alarm; in the spring it also utters a soft ringing note, which may be considered its song, and which is certainly not unmusical. It is a bird of very active and lively habits, for ever examining the trees and bushes for insects, and in its search for them constantly assuming the most grotesque and often beautiful attitudes. And it is remarkable for being always about the first among small birds to spy out an enemy, a weasel or an owl, the latter of which it most perseveringly and unremittingly persecutes whenever it ventures forth into daylight.

BOA. A genus of aphidian reptiles which have no poison fangs, or other venomous apparatus, but which are nevertheless very powerful as crushing serpents, as they can very rapidly, and by what seems a sort of absolutely frensied motion, it is so rapid, twist themselves round the bodies of tolerably large animals, and crush them to death. As is the case with all serpents, they have no means of masticating or dividing their prey in any way, and as a compensation, their gape is remarkably wide, and their throat and gullet capable of much dilatation.

The presence or absence of the moveable poison fangs, which are not fixed in the maxillary bones, is not in itself a sufficient criterion of a serpent being poisonous or not poisonous; for there are some which have the fixed teeth perforated with tubes, and are capable of inflicting venomed wounds by means of these. See OPHIDIA. Some of those which have been included in the genus *boa* have this latter kind of poisoning structure; but these are very properly separated from the true boas, which kill their prey by muscular strength only; and after this separation has been made, the genus still contains a number of species.

These formidable reptiles are found only in the warmer parts of the world, generally in those where vegetation is rich, and many of them near the waters rather than in the dry and open places. The Malay peninsula, on the continent of Asia, the Oriental Isles, and Brazil and Guiana in tropical America, are the parts of the world where they are most abundant. It thus seems as though the utmost energy of those powers which produce natural action were required for the development of these animals; and there are few that suffer a greater falling off of their activity when they are brought into cold latitudes. Those which have been brought to Europe as curiosities (for it can be only as curiosities that they are brought, as they are useful to man no where, neither are they in any degree ornamental), have continued to show their periodical voracity while on board ship in the very warm seas; but after they come into the cold latitudes they have to be kept warm by artificial means, otherwise they show hardly any signs of life. Those which have been brought to England and kept alive have, besides their forms, shown hardly any thing else than how tenacious of life these reptiles of the warm climates are, and how long they can live without food where there is not sufficient heat to call their system into activity.

Nothing shows more convincingly the dependence of the different parts of the system of nature upon each other, than those large and formidable reptiles of the warm climates. Though they can wriggle along with considerable rapidity for short distances on land, though most of them can swim, and though they can make very violent momentary efforts in the capture of their prey, yet they are incapable of much change of place by locomotion; and it appears to cost them no small effort before they can be roused even to that activity which is necessary for taking their food. Thus they must remain in their localities and abide what comes; and their powers of endurance are well suited to this state of life. When they are not excited, there appears to be little waste in their system; and their power of swallowing is so great that one full meal serves for weeks; and, for a considerable time after it is taken, the whole energy of the animal appears to be so completely absorbed by the work of digestion, and its powers both of attention and of motion so completely deadened, that it makes no attempt at resistance or even at escape. When hungry or otherwise excited, these animals are very formidable, and their motions are so quick, and their strength in crushing is so great, that it is very hazardous to approach them; but when they have taken a full meal, a naked savage may with impunity go in upon the most powerful of them, and fell it by blows on the head with a club; and so completely are its faculties engrossed by the inward labour of digestion, that instead of making efforts to escape from the blows, it hardly writhes under them, but dies with the same comparative quiet as it is then bearing.

There is some confusion between this and some of the nearly allied genera, as there is about most of the serpents, and indeed of the whole class of reptiles generally speaking, so that the character and conduct of one have sometimes been ascribed to another. There is a proneness to exaggerate every thing about reptiles, and there is a popular aversion, which those who have the best opportunities of examining them have not always the power of overcoming. Besides, their habits are obscure and retiring; and in order to be observed, they must be searched out with more diligence than most animals. The places which they frequent are also not the most inviting, or even the most safe; they are the tangled brakes and margins of marshes in very hot climates, which are unhealthy, and though the reptile of which the observer is in search may not be venomous itself, there is no knowing where venomous ones may be lurking; and as these are usually smaller and more easily put in motion than the larger ones which are not venomous, it requires no small nerve as well as caution to thread the serpents' preserve with the requisite degree of attention. Hence, there are probably more undescribed or inaccurately named and described specimens of reptiles in the collections and museums, than there are of all the other vertebrated animals taken together.

The form and number of the scales, especially those on the under side of the body and tail, have been, in the true serpents, among the chief means of generic distinction. These scales are their proper organs of locomotion, and the only external organs, excepting such as appear on the head or are attached to the extremity of the tail. The external means of distinguishing one serpent from another, when they are in their proper haunts in free nature, are therefore not only much more limited than in the case of animals which have feet or wings, or even fins. They are also obscure, because the parts are small and inconspicuous, and if the number or the form of the scales are the only distinguishing characters, then the species or even the genus of a serpent cannot be ascertained, unless it is killed or captured.

This uncertainty is the cause of another: for, as we cannot understand the character of the one which gets away, we are not sure whether those foundations of character which we adopt are constant or not. We know that, in some of the species, the number of cartilaginous pieces which form the rattle at the extremity of the tail, increases with the age of the animal, and also that some of them are apt to be broken off by accident; and it may be possible that the number and also the form of the scales on others change with age. Colour too is, though necessarily relied on in cases where the means of distinction are so few, not worthy of implicit confidence, especially when we come to the nicer distinction of individuals which have a very strong general resemblance to each other. These difficulties, and taking them altogether they are of a kind not easy to be removed, are but too good an apology for the mist of obscurity which hangs over this department of natural history, and renders it so dark that he who writes on it with the greatest apparent confidence is generally the least worthy of credit.

Taking the distinctive character from the scales on the under part of the belly and tail, the tribe or family of *boa* comprehends all those serpents which have these scales entire, or of one plate extending from side to side without any joint upon the mesial line, and which at the same time have neither a rattle nor a spinous prolongation at the end of the tail. It is by this series of single scales that the family *boa* is distinguished from *coluber*, in which there are two rows of scales along the same part; but there have been specimens observed with some of the scales on the under part double, while the majority were single. It should seem that the larger crushing serpents of the south-east of Asia belong to the coluber family, and to the genus or sub-genus python (see Coluber), while the larger species of true boa are found only in the tropical parts of America; and they seem to be found nearer the water, and generally to inhabit more humid places than the pythons of the East.

The boas have a spinous hook at each side of the vent, the body compressed, and the tail prehensile, or capable of holding on by a tree or a branch, while the rest of the body coils round the captured animal, and sometimes draws it toward the tree, where it is crushed to death. The scales upon the upper part of the body and hinder part of the head are small. The structure of the head and jaws varies considerably, and gives rise to some subdivisions of the genus.

Some of the species attain a very large size, measuring thirty or forty feet in length; and when they are of that size they can master deer and even buffaloes. Their mode of killing is always by crushing in the coils or folds of their bodies, if the prey is so large as to require that operation; and they lick or smear it all over with their glutinous saliva, before they begin to swallow it. When the prey is of smaller size, they seize it at once in the vast opening of their mouths.

No one who sees these animals only in a state of inaction, and with the mouth shut, and the neck of of the usual dimensions which it has in that state, would readily form an idea of the vast extent of their gape and the wideness of their gullet; but the one and the other will so open as to take in an animal of much greater diameter than the serpent itself. All the true serpents have the under jaw articulated in a peculiar manner, which will be explained in the article Ophidia; but we may mention here that the lower jaw is not articulated upon the bones of the cranium, but upon two additional bones; and that these again are not articulated upon the bones of the cranium, but attached by muscles and ligaments, which admit of considerable extension. A portion of the anterior part of each jaw is also formed of ligaments or tendinous matter, which is flexible and capable of being stretched.

This mouth, therefore, not only differs from but is in a great measure the very reverse of those mouths with which we are familiar in ordinary animals. In these the power of the mouth is in shutting the jaws against each other; and whether the teeth be fitted for tearing, for cutting, for grinding, or for simple prehension (as they are in most fishes), the efficiency of the animal, and the danger, if it is a powerful and rapacious one, are in the bite. The snakes, or harmless serpents, which have in the form of their skeletons some rudimental resemblance to the saurian reptiles, have the mouth, though rather loose in its articulation, constructed in a manner similar to the rest of the vertebrated animals; and, therefore, its most powerful action is in the bite, though that bite is, from the looseness of the articulation, very feeble, which is the reason that the animals are so very harmless.

Of the true serpents, those which have poison fangs, have not in general the gape so capable of extension as the boas and others which are without poison apparatus; but even in these it is dilatable to a degree quite unknown among any other animals, and quite sufficient to rank them in the same suborder with the crushing serpents.

In these, the jaws have their greatest action in opening. The sides of the gape, as they appear when the mouth is closed, are not only brought into one plane, but the junction of both jaw-bones in front and that of the lower ones, or rather of the intermediate bones, with the cranium behind, are greatly extended; so that the entire circumference to which the mouth opens as a swallowing organ is much greater than the measure round both jaws to the extremity of the gape when shut. A fox trap, or a purse which opens by a circular strap, the two sides or valves of which fold completely back from each other till they are in the same plane, will afford an approximate notion of this formidable gape. But it is only an approximation, for the stretching of the ligaments which connect the different bones can, upon occasion, double the opening made by the bones themselves. Bringing the gape to this state is a work of some time with the animal, and it seems to excite the muscular part of the body at the same time; for the moment that the mouth is opened to the requisite extent, the snake darts on its prey. The teeth in both jaws, though not biting teeth, or capable of inflicting any deadly or even serious wound, are recurved, so that they assist powerfully in the act of swallowing whatever the great gape can admit. Figures and even stuffed specimens of these snakes are sometimes represented as biting at the throats of those animals round which their folds are coiled; but this would be a very unnecessary operation to them, as it could in no way facilitate their purpose, which is to swallow the animal entire. If the animal is large, the crush of the folds is sufficient to kill it; and if it is small, even that is not necessary, as it is taken into the mouth at once—a gulf from which there is no return.

The smearing with the slimy saliva tends to make the prey slide more easily into the gullet, which dilates to receive it to the same extent as the opening of the mouth. The form of the teeth and the peculiar junction of the jaw bones, in consequence of which they can act either all at the same time or by turns, urges the prey inward, something in the same manner as the awn or beard of a barley-corn moves up a man's sleeve when he moves his arm, or as hairs work into a compact mass in the operation of making a hat, or any other process of felting.

It does not appear that any of these serpents break, or have the power of breaking the skull of their prey; because a case of bone of the form of a skull is very difficult to break by compression all round it. The gape is therefore adapted to admit the head of the animal, and then the rest follows as a matter of course.

The quality of the slimy matter with which the prey is covered has not been examined; but it is not improbable that it has a solvent as well as a smoothing power, and assists in digestion as well as in deglutition. At all events the work of decomposition in the prey soon begins; and as there can be little except solvent action exerted upon it, that action must be very powerful, and it constantly goes on along the whole canal from the mouth till the prey is completely reduced to matter fit for the nourishment of the reptile.

When we consider this wonderful mode of feeding, we need hardly wonder at the stupor which ensues; for, what with the dilatation of the mouth and gullet, what with the action of the jaws and teeth in "working in" the prey, to say nothing of the vast muscular effort requisite in crushing to death an animal, round which the serpent's coils appear not much thicker than those of a cable round a mast, the feeding of one of these crushing serpents is among the most laborious operations which we know of, or can imagine, in the whole range of animated nature. And though there certainly is nothing pleasing in the study of these singular creatures, they form one of the most remarkable, and far from one of the least instructive studies that we meet with in the whole compass of natural history.

We have entered so much into the general structure and action of these reptiles, that we shall be enabled to dispose of the different species very briefly. Cuvier makes five divisions of them, besides the allied subgenera, which have more resemblance to the boas than to any other genus of serpents.

The first are those which have the head, to the point of the muzzle, covered with small scales, the same as those on the body; and the scaly or horny plates on the jaws are not grooved or dimpled. To this division belongs *Boa Constrictor*, the "roebuck serpent," one of the largest and most formidable of the genus. It is easily known by the markings along the back, which are very distinct. These consist of a regular succession of spots, the whole length of the mesial line, alternately black, and in the form of irregular hexagons, and ovals of a yellow colour, and broken by notches at the sides. The annexed figure will give a general idea of this powerful reptile.

It has sometimes been supposed that the boa constrictor exists in the old continent, in the hottest parts of Asia and Africa, and there only; but, as has been mentioned, the probability is that the large serpents found in those places are colubers, and that the true boa constrictor, answering to the generic description, is found only in the richer parts of tropical America.

A second section of the genus have scaly plates behind the eyes, as well as on the sides of the jaws and front of the muzzle, by which they are easily distinguished from the former section, though, like that, they have no dimples or furrows on the jaws. They are also readily distinguished by the markings on the upper part, which consist of a double row of round black spots down the sides of the mesial line, with eye-shaped spots on the flanks. The general colour is brown. The species which forms this section is *Boa scytali* of Linnæus, and *Boa aquatria* of Prince Maximilian. It is much more aquatic than the former; and while that watches for its prey in the thick and tangled parts of the woods, this waits more frequently in the waters, and seizes and swallows the animals which resort there to drink.

Boa Constrictor.

A third section have scaly plates on the muzzle, and those on the sides of the jaws furrowed or dimpled. The species which forms this section is the speckled boa (*Boa cenchris*, Linnæus); its ground colour is yellow, marked along the back with a succession of brown rings, and with variously formed and coloured spots along the flanks.

These three species or sections form the true or characteristic boas. They all attain nearly the same size, and do not differ much in their habits. They all frequent places which are humid, although some inhabit further into the marsh, or are more frequently found in the water than others. They are often found with the prehensile tail curled round a tree by the side of a pool or stream, waiting for their victims, and at other times they are stretched along the water, in which state they bear some resemblance to floating sticks. They are not however, very often seen, because the places to which they resort are very unwholesome, and not very tempting in other respects.

The time of their greatest activity is said to be during the subsiding of the floods after the rains, a season at which the places which are left bare are peculiarly pestilent; but the different species of living creatures to which these places are native, whether animal or vegetable, are then in a state of energy and activity, unknown in more open and healthy places. Indeed it is the very rankness of these places which makes them so rich,—their pestilent qualities, which enable them in the course of a few months, or even weeks, to send forth a vegetation and produce an assemblage of living creatures which would be the work of years for the more sober (but to man more healthy) powers of life in temperate climates.

As the hot season advances, the action of the sun begins to destroy what it was so powerful in producing while the ground was humid. This of course takes place first at the higher level of the inundation, where also the productiveness of the former part of the season commenced; and it gradually creeps onward, as the water dries up and the vegetation withers, toward the channel of the river whose overflow produced the inundation, from which this excess of living action arose. These, in many places the productive surfaces, at least in so far as seasonal plants and seasonal animals are concerned, is reduced to a mere line, and the food of these large serpents becomes scarce, and not easy to be had. But they are tempered to all the changes of climate of which they are so exclusively and peculiarly native; and the excess of heat and drought begins to have an effect upon them not altogether dissimilar to that which they experience when they are carried into colder climates.

It appears to be a general law of nature, and it is one the knowledge of which is of much practical utility, that if any animal can bear with difficulty a change from its natural degree of heat in the one direction, it can bear it just as ill in the other. The power of endurance appears to extend from what may be called the mean natural temperature, about equally toward cold and toward heat. We find that those animals which hybernate during the cold months in high latitudes are most oppressed by heat when the weather is very hot. We have examples of this in the case of moderately low average temperature, in bears, marmots, and bats, which though they become languid or wholly dormant during the rigour of the winter, feel very uncomfortable in the heat of the day during summer; so much so, that they generally keep in concealment then, and come abroad only when the sun is low, or in the twilight. We have an instance of it in a case of much lower average temperature in the common frog. That animal cannot bear a degree of heat equal to the average temperature of health in the human body; and yet it passes into a state of inactivity as soon as the cold of winter begins to set in. In the boas, and it is the same with many other creatures which inhabit similar places, we have instances of constitutions tempered to the very hottest climates only, but which are incapable of bearing the greatest heat even there. Indeed incapacity of enduring the direct heat of the sun when it beats in the intensity of its fervour upon the dry and parched surface, appears to be one of the reasons which confines these creatures to the thickets, the marshes, the banks of the rivers, and, when the sun is hot, and the marsh nearly dry, to the water itself. Nor if we examine all nature shall we find any instance in which the ranges upward and downward are not in proportion to each other. That they shall show the same range according to the scale of the common thermometer,—as for instance that an animal which is in its most natural activity at 60°, and becomes still at 32°, shall become as dull at 90°, is another matter, and one which we cannot expect. The degrees of the thermometer are merely equal expansions of the mercury, or spirit of wine, or other thermometric substance; and we know nothing of the relative powers of heat by which these are effected, only we trace the most apposite analogies in favour of the hypothesis that the force of heat requisite for producing equal expansions not only varies with every degree in the same substance, but that in no two different substances does it vary according to the same law.

Thus, even the boa, all-formidable as it is, dwelling in places where miasmata is foul, and life brought into danger from the tainted air, even if there were danger of no other kind, has got a lesson to teach those who will take the trouble of studying it, and that lesson is of more extensive and more useful application than many which are obtained from more inviting creatures in more healthy localities. Following out our observation a little, we find that this law of the range of temperature which an animal can bear, being equal from the mean toward greater cold and toward greater heat, is not a barren or an isolated law, but one which is intimately connected with the physiological character of the animal, and varies with other variations, not in the larger divisions only, but in different individuals of the same species, even in those of the human race. The range of endurance of temperature appears to be always in proportion to the energy, or perhaps we may say the development, of life, the rapidity of the circulation and respiration, and the readiness of the animal for whatever action best suits its organisation ; and we know that the capacity for constant action in the animal, and the necessity of frequent supplies of food, are also in proportion to these. Animals which have this general activity of system do not become heavy after their meals, and however the cold pinches, though they sometimes shiver, they do not become dormant. They are thus the busy creatures. In this their general habit they make the nearest approximation to man's power of enduring all climates ; they are consequently the best fitted, in their physical constitution, for domestic purposes, and their dispositions are in accordance ; they are the most docile, the most obedient, and the most gentle in their manners. The ruminantia among mammalia, and the gallinidæ and pigeons among the birds, are familiar instances.

Thus, when we come to compare the animals, race by race, with each other, we find the adaptation to savage and civilised countries as perfect as that to different climates and different kinds of surface. The nature of the savage animal is fitted only to the savage land ; and when man takes possession, cultivates, and then alters the physical condition, the savage creature, which would be inconvenient to man, were it to remain in his neighbourhood, finds in this physical change, to which its stubborn nature cannot accommodate itself, that the country which man has thus changed by his culture is no longer its country, and it fades away, and gradually disappears, leaving only its bones in the soil, to testify what the country once was, and to what it may again return, if man shall slacken the hand of his cultivation. There have been some very striking instances of this return of savage animals to places from which they had been expelled by cultivation in the modern history of India. After those intestine wars which had left so many parts of that land of powerful natural action without inhabitants, the jungle overran the fields, and hid every vestige both of culture and of human habitation ; and along with the jungle, the larger species of the cat tribe, the tyrants of the sultry wilds, multiplied in vast numbers, and absolutely appeared to increase faster than one would have, from the previous state of the country, supposed to be their proper rate of increase. Even the lion, whose presence at all in that part of the world, at least for some centuries, had become a question, was found in no inconsiderable number:—so energetic and so active in concert are the powers of wild nature.

But that portion which is more peculiarly valuable to man in a state of civilisation follows the law of civilisation, and increases with its increase. This is apparent not only in the animals, but in the plants upon which those animals feed ; and thus, when we take our survey upon the broad and unfettered principle, we not only see that all the parts of nature act in harmony with each other, but that the whole act so much in concert with man, and so strengthen his hand and encourage his heart in that course of improvement which is most favourable both to his physical comfort and his mental and moral development, that it is impossible to avoid seeing that "Herein is the finger of God : that here is wisdom of plan and perfection of execution above all human skill and power—above all human admiration." Such are the wonderful displays of the wisdom and goodness of the Almighty Creator, which result from the proper contemplation of his works, be the place, the season, or the subject, what they may ; and it is these which render the proper study of natural history so delightfully instructive, and make the abuse of it, by trifling and narrow views, the most pernicious and reprehensible of all idle dissipations. But, to return to the great serpents by the margins of the waters in tropical America.

We have said, that as the intensity of the dry heat increases, these animals become languid, and before its close one may pass through the places of their usual resort without the alarm-note of a single hiss grating on the ear The brick-tinted earth, the withered leaf, the dry reed, ready to take fire spontaneously, if the wind should rustle it before the rain shall have drenched, are all silent in the stilly air and under the burning agency of the sun ; and to a casual observer, who sees the country only in this extreme of one of its seasons, it appears as if Desolation had set his seal there, never to be broken.

But the Genius of the Andes looks down in pity from his throne of eternal snows, amid roaring volcanoes and rending earthquakes, upon those plains all hastening to destruction, The air on the surface of the ground is wonderfully transparent ; objects which were not visible begin to come out, and sounds are heard of which the ear could take no note only a day bygone. The small quantity of water which played between the earth and the nether air seems to have floated upward, as if the earth were about to be deprived of even that unsatisfying draught, and the wail of the exhausted cascade comes shrilly and feebly through the forest, as if it were the prelude of its soon being silent for ever. There is a white cloud upon the distant hill, and the upper air is gummy ; it looks as if all humidity were in motion upwards, escaping to another region—it may be to another planet. As the sun declines, the white cloud blackens, and the last rays of the sun stream in like molten gold. But, unusual in such a climate at such a season, not a drop of dew is formed, and thus the fear is in part realised. As twilight fades, and in those latitudes it fades rapidly, the stars are surrounded with haloes, and the southern cross resembles a constellation of comets ; but all are soon lost in darkness. Then the winds, which have hitherto been more than usually still (for the dew of the evening brings a little breath even in the utmost intensity of the heat), begin to blow their little signal blasts from every point of the compass in turn; yet the leaves are, if possible, more still than ever, and it is pitchy dark. But there comes a gleam of light, which envelopes earth and air, and, ere the mind recovers its surprise, crash go the elements, as if a thousand thunders of the loudest voice were concentrated into one peal. Then, flash after flash, and peal after peal, as if the night of final destruction had arrived. And the commotion is on no local or stinted scale; for well nigh "from Darien to the vexed Antarctic main," the Andes on their eastern slope are in one continued glare of lightning, and one voice of thunder, amid which the fire of the volcano is not seen, or the sound of the earthquake heard. Then are "the windows of heaven opened," and amid the glare of the lightning, and the bellowing of the thunder, the clouds, as it were, tumble headlong, till the earth receives one continuous cascade from the sky, the section of which is many hundreds of miles in area, and Niagara itself is but the emptying of a bottle in comparison.

This is an arousing for all the creatures, from the highest roosting bird down to the boas, and the sounds of terror at the present danger, and of joy at the plenty which this violent outbreak of nature is sure to bring, are blended together in so many notes and keys, that the creatures appear to be as much in chaos as the elements, and it is wriggling, and crawling, and running, and climbing, and flying, all to save the life. Nor is it any wonder; for before man can venture to look abroad from his hiding place, every ravine has its cascade, every hollow its lake, and each of the larger rivers rolls onward as a sea, as if they had mustered their powers to give battle to the ocean. Such is the turn of the tropical season, which raises the great serpents of America from their temporary inaction, and sends them high in the trees, or distant to the banks, to begin the season of activity.

Besides the three sections of boa which have been mentioned, there are other two, which are somewhat different in the characters of their heads, do not attain the same dimensions, and are not so formidable. One of these, an American species, is the *Boa hortulana* of Linnæus. It has horny plates on the muzzle, and the jaws furrowed with a groove which passes under the eye, and terminates in a slit a little behind that organ. The other is a native of the east, and is less closely allied to the typical species: it is the *Boa viperina* of Shaw. It has the body with a sort of crest or keel along the back, and very much compressed. There are no furrows along the jaws or under the eyes, but the plates on the muzzle are a little raised in the centre, something in the form of double wedges, with the one point in advance and the other to the rear.

The three sub-genera which have been separated from all the sections of the boas, and not included in the colubers, are Scytali, Erix, and Erpeton, of which some account will be given under these titles.

BOBARTIA (Linnæus). A genus comprising three species of perennial herbs, introduced from southern Africa. Class and order *Triandria Monogynia*, and natural order *Irideæ*. The flowers of the bobartia are not only curious, but very beautiful, as all the order are to which it belongs.

BOCCONIA (Linnæus). A family of two species of evergreen shrubs, natives of the West Indies. Class and order *Dodecandria Monogynia*, and natural order *Papaveraceæ*. Generic character: calyx of two sepals, deciduous; stamens seated below the germen, filaments short, anthers linear, and erect; style short, cloven; capsule on a foot-stalk, pod-formed, crowned with the style, one-seeded, two valves opening below.

BŒHMERIA (Jacquin). A genus of various character, comprising fourteen species of shrubs, under shrubs and herbs, chiefly from Nepal, and the West Indies. Class and order *Monœcia Tetrandria*, and natural order *Urticeæ*. Generic character: male flower—calyx four-parted, urceolus, none; filaments awl-shaped; anthers roundish, double. Female flower—calyx none; scales clustered, oblong; germen inversely oval; style elongated, filiform, feathery; akenium with the persisting style. These plants are only useful in botanical collections, none of them possessing any known useful properties.

BOG MOSS is the *Sphagnum vulgare* of cryptogamic botanists. It is the most useful of all the mosses for packing fruit, or delicate plants, and is usually found on bogs, or in wet woods.

BOG RUSH is the *Schœnus* of Linnæus, a genus of five species, four of them foreign. Class and order *Triandria Monogynia*, and natural order *Cyperaceæ*.

BOLBOCERAS (Kirby; *Odontæus*, Zeigler, MSS). A genus of lamellicorn beetles (*Scarabæus*, Linnæus), separated by Mr. Kirby, in the Linnæan Transactions, vol. xii., from the Latreillian genus *Geotrupes*, from which it chiefly differs in the structure of the antennæ, which are eleven-jointed, the three terminal articulations forming a very large compressed and suborbicular club, of which the central plate is concealed by the two outer ones, which enclose it as in a box. The mentum is entire in front, one of the jaws is entire and the other with two teeth, and the legs are inserted at equal distances. The males of these insects are distinguished by a long and erect horn upon the crown of the head. The type of the genus is the *Scarabæus mobilicornis* of Fabricius; it is about one-third of an inch long, and of a castaneous black colour. It occurs, but rarely, in various places near London. Latreille was informed by one of the sons of the celebrated ornithologist Le Vaillant, that frogs and toads are very fond of these insects, and that he had obtained many specimens by opening the bodies of some of these reptiles. This species varies in colour, and some authors have considered the *Scarabæus testaceus* of Fabricius merely as a variety, but Mr. Stephens regards them as distinct: his reasons, however, founded chiefly upon the development of the horns of the head and thorax appear to us to be inconclusive, as the same kind of distinctive variations occurs in other cornuted beetles, as in *Siagonium quadricorne* (see Zoological Journal, No. 9, and Kirby and Spence, Introduction, vol. iv. p. 166). It is a curious circumstance, and one which requires considerable investigation, as bearing upon the analogies of cornuted animals amongst the higher groups, that amongst the males, which sex alone is furnished with these appendages, there are generally to be observed two kinds of individuals, the larger ones being much more robust and armed with the most fully developed spines or teeth, and the smaller ones having the armature of the head and thorax remarkably small, no intermediate specimens being found amongst them, whence it has been supposed that the latter specimens are neuters. In the insects in question the reputed variety, *Scarabæus testaceus*, exhibits another mark of inferiority in its pale colouring, which is generally, amongst insects, regarded as a mark of immaturity. The genus in question is widely distributed, being found in every quarter of the globe. Dejean enumerates sixteen species.

BOLETOBIUS (Leach). A genus of coleopterous insects belonging to the family of the rove-beetles, *Staphylinus*, Linnæus, and to the sub-family *Tachyporides*. Its head is elongate, the antennæ slender, the palpi rather long and filiform. The species are prettily marked with blue-back, varied with red or yellow. They are of small size, not exceeding a quarter of an inch in length, but are extremely serviceable in the economy of nature, from their habits of feeding upon decaying boleti and fungi, whence the generic name. They form a portion of the genus *Tachinus* of Gravenhorst's work upon this family. Mr. Stephens enumerates eighteen species, of which the *Staphylinus lunulatus* of Linnæus is the type. It is a pretty insect of a red colour, with the head, breast, and base of the abdomen black, the elytra blue-black, with the base and margin of the tips red. It is a common species in various parts of England.

BOLETOPHAGUS (Fabricius; *Eledona*, Latreille). A genus of heteromerous beetles, belonging to the family *Diaperidæ*, of which it forms a separate section. The body is ovoid, very unequal above, and deeply striated in the elytra; the margins of the thorax are toothed; the antennæ are terminated by a perfoliated mass of three or five joints, and the inner side of the preceding joints is acutely produced. The head of the males is often armed with horns. The species reside in fungi, Boleti, &c., in a decaying state. Dejean enumerates six species in his Catalogue, first edition, of which one only is found in England, namely, the *Bol. agricola* (or rather *agaricola*, from feeding upon agarics). It is of small size, being only one-eighth of an inch in length, and of an obscure black colour. Another of Dejean's species, *Spinosulus*, Latr., has only three joints in the club of the antennæ, and forms the genus *Coxelus* of Zeigler.

BOLETUS. A family of fungi very often seen growing out of the decayed parts of trees. The boletus is distinguished from the mushroom by a very striking difference: the under side of the first is crowded with circular cells, that of the latter by diverging gills. The boletus grows to an immense size in the humid woods of the tropical countries; assuming the most fantastic and frightful forms, but of no known use. One of the family, the *B. ignarius*, is manufactured into a substance which serves for tinder.

BOLTONIA (L'Heritier). A genus of two species herbaceous perennials, from North America. They are syngenesous plants, and consequently in the natural order *Compositæ*. They are both occasionally met with in flower borders.

BOMBACEÆ. Cotton-tree family. A natural order of dicotyledonous plants, containing fourteen or fifteen genera, and about fifty species. It is closely allied to the *Malvaceæ* or mallow tribe, and by some authors is considered merely as a section of that order. It differs however, from the malvaceæ, in the calyx not being truly valvate, and in the tube of the stamens being divided into five bundles. The order bears a strong affinity to the *Byttneriaceæ* and *Chlenaceæ*.

The essential botanical characters of the bombaceæ are: sepals five, cohering in a truncated or irregularly-cleft tube, sometimes provided with bracteæ; petals five, regular, occasionally wanting, and then the inside of the calyx is coloured; stamens five, ten, fifteen, or more; filaments united at the base into a tube, which is adnate with the base of the petals, dividing at the apex into five bundles, each of which has one or more one-celled linear anthers; ovary of five carpels, either distinct or united; styles equal in number to the carpels; fruit variable, capsular or indehiscent, provided with five valves, bearing the dissepiments in the middle; seeds often enveloped in wool or pulp.

The plants belonging to this order are shrubs or large trees, with showy flowers, found in hot tropical regions. They are natives of South America, the East and West Indies, and Africa.

The wood which they furnish is generally light and soft, and they are propagated by cuttings and seeds.

Like the mallows they are mucilaginous, and do not possess any deleterious properties.

Bombax is the genus whence the name of the order is derived. *B. pentandrium* or *Eriodendron anfractuosum*, the cotton tree, is a large tree which occasionally attains the height of one hundred feet. It yields a kind of gum which, when combined with spices, is used in India in bowel complaints. The fruit is oval and larger than a swan's egg, having a thick woody covering, and containing a quantity of short dark cotton, inclosing many roundish seeds the size of peas. These seeds are eaten by the inhabitants of the Celebes islands. *B. ceiba* has a spiny trunk, and is one of the tallest trees in both Indies.

Bombax.

Its wood is used for making canoes. When the trunk decays it becomes the nest of the Macaca beetle, the caterpillar of which, when properly prepared and dressed, is esteemed by some people a great delicacy.

The Durion of the Indian Archipelago is a most delicious fruit, the product of one of the plants belonging to this order. This fruit is at first disagreeable from its fetid odour, whence the plant gets the name of *civet durio*, but it soon becomes a favourite article of dessert.

To this order belongs the *Adansonia digitata*, baobab or monkey's bread, the largest known tree, whose trunk has been found ninety feet in circumference. The particulars in regard to this tree and its uses, are fully detailed under the article ADANSONIA.

The genus *Helicteres* receives the name of screw-tree from its curious spiral seed-vessels. *Cheirostemon*, or the hand-plant of Mexico, has its name from the five bundles of stamens being thick, coloured, and turned on one side so as to resemble a paw with five claws. *Ochroma*, and the genus of the order, is so called on account of its yellow flowers. *Ochroma lagopus* is a large tree with diverging branches, and leaves more than a foot long. Its wood is so light as to serve for corks to nets. Its capsules contain a soft down, which is used in the manufacture of English beavers. The seeds of several of the species included in this order are enveloped in long hairs, like those of the true cotton. They cannot, however, be used in manufacture, owing to the want of adhesion between the hairs. The hairs are quite smooth, not rough and feathery like those of the cotton plant. The woolly matter furnished by the *Bombax ceiba, Chorisia speciosa*, and several other species, is used for stuffing chairs and cushions.

Any medical properties which the plants of this order possess seem to depend solely on the mucilage which they contain.

BOMBARDIER BEETLE. Under this name the species of the coleopterous genus *Brachinus* are known. These insects, whose generic character will will be found under their generic name, possess a very remarkable power, enabling them to defend themselves

Bombardier Beetle.

against the attacks of their enemies. The British species are of a rather small size, being under half an inch in length, of a blue-black colour, with the thorax of a red or yellowish colour. In general, they conceal themselves beneath stones; but when they are disturbed, one is surprised to hear a noise resembling the explosion of a musket in miniature, accompanied by a considerable discharge of bluish smoke from the anus. Many of the carabidæ have the power of ejecting an acrid and caustic fluid, but in the brachinus this is so extremely volatile, that it evaporates immediately on coming into contact with the air. It is, moreover, of so pungent a nature, as to irritate any part of the body upon which it may happen to fall, tinging the skin with a dusky mark, which remains for several days, and causing a most violent pain if it happen to touch the eyes. Indeed, according to M. Leon Dufour, who has studied the structure of these insects with particular care, the odour of this vapour has a striking analogy with that exhaled by nitric acid, and is caustic, reddening white paper. The insect, notwithstanding the assertion of Mr. Millard to the contrary (Outlines of British Entomology, p. 221.), not only possesses the power of causing this discharge when handled, but is able to repeat it successively for a considerable number of times,—Solander, who first observed it, says twenty (Mem. Acad. Stockholm. 1750); and Mr. Cooper, the celebrated R.A., counted thirteen discharges in rapid succession (Stephens' Illustrations Brit. Ent., I, 35). The discharges, however, become less violent, and afterwards, instead of smoke, merely a brown or yellow fluid is emitted, as if the more elaborately concocted liquid had been consumed. The insect may be made to play off its artillery at any time, by scratching its back with a needle; and by bending the segments of the abdomen, it is able to direct the smoke in any direction. It is in self-defence that these discharges are generally made, since, like many of the smaller carabidæ, the bombardier beetles are preyed upon by the larger species of the same family. When pursued, therefore, and on the point of being seized by its enemy, it has recourse to this stratagem, by lying in its pursuer's path, which advances with open mouth to seize it, and by immediately discharging its ammunition. Confounded by the scent, and unable to see from the smoke, the enemy draws back until it has recovered from its effects, when the pursuit is renewed, and a second discharge takes place, and which is continued, either until the brachinus has gained a place of safety, or the pursuer is enabled to seize its prey, which it immediately destroys by tearing off the head.

M. Dufour has given a very minute account of the internal structure whence this explosive fluid is produced in *Brachinus balista* (Annales du Musée, vol. xviii, p. 70, and Bulletin des Sciences, Soc. Phil. July 1812) and which consists of a double apparatus, according to Messrs. Kirby and Spence (whose abridged account we have thought most suitable), one on each side in the cavity of the abdomen, both formed of two distinct vessels. The first, which is the innermost, presents itself under two different aspects, according as it is contracted or dilated; in the former case it is a whitish irregularly rounded, soft body, apparently glandular, placed under the last abdominal segments, communicating at one end with the reservoir, and terminating constantly at the other in a very long and slender filament; in the second case, or when it is dilated, it resembles an oblong, membranous diaphanous sac, filled with air, then occupying the whole length of the abdomen, and appearing free except where it communicates with the reservoir. The second vessel or reservoir is a small spherical brown or reddish body, constant in its form, internally hollow, placed under the last dorsal segment, precisely above the rectum, and opening by a small pore into the anus, so that the tail of this little beetle may be regarded as a battery mounted with two pieces of cannon, which our alert bombardiers fire alternately without intermission until all their ammunition is expended.

The generic name is derived from the Greek, and signifies to make a noise; and in allusion to this property some of the species are named, fumigatus, crepitans, sclopeta, causticus, explodens, bombarda, exhalans, &c.

BOMBAX (Linnæus). The silk cotton tree belongs to the class and order *Monadelphia Polyandria*, and natural order *Bombaceæ*. Generic character: calyx nearly bell or pitcher shaped, abbreviated, irregularly from three to five-cleft; petals five, overlapping each other at the base; filaments united in bundles; anthers adnate or versatile, sometimes kidney-shaped, two-celled; style simple; stigma headed, lobed; capsule woody, five-celled, five-valved; cells filled with silky cotton; dissepiments central, seeds several. In addition to what has been observed of this tree in a preceding article, we may notice further, that it is found in South America, in Africa, on the Indian peninsula, and all over the same degrees of latitude to the eastward as far as China. The silky substance contained in the capsules, has been tried by both spinners and hatters for their respective purposes, but it wants tenacity of fibre, and is therefore useless for the fabrication of any durable material. Thin mattresses are however stuffed with it in India, and for which the silk cotton is so far eligible, that it is exceedingly light. Notwithstanding the tree is generally found between the tropics, the leaves are deciduous, that is, falling after the seeds are ripe, and renewed immediately after the flowers come forth in the next season. The leaves are compound; some species, as the *B. ceiba*, have five leaflets, others seven, all proceeding from the point of the common foot-stalk. This last species presents one of the most magnificent spectacles when in flower that possibly can be conceived. This tree is plentiful in the southern provinces of China; it grows like, and very much resembles, the largest walnut trees of England. In the month of March, and before the leaves appear, the tree comes into flower; every twig of the widely extended head bears a large tulip-like scarlet flower, remaining in perfection for a week or two—the first flowers on the points of the shoots being succeeded by others from the sides. As a proof of the plenty of these trees in the neighbourhood of Canton, most of the coffins required for the mortality of the vast population of that city, are made of the slabs of the bombax, or silk-cotton tree as it is called by the English, and *moc-main* by the Chinese. These coffins are soon made; a butt is chosen corresponding to the size of the defunct; four slabs are sawed off at right angles, the square centre is used for other purposes, and the four slabs are fastened together again to form the rude coffin. The timber is light, and of inferior quality. The genus is nearly allied to the *Eriodendron* of Decandolle.

BOMBYCILLA (Waxwing). A very peculiar genus of birds, belonging to the *omnivorous* division of the order *Passeres*, in Cuvier's arrangement, nearly allied to the CHATTERERS (*ampelis*), and also to the ROLLERS (*coracias*), but having sufficient distinct and peculiar characters for entitling them to stand in the systematic arrangement as a separate genus.

The generic characters are—the bill strong, short, rather compressed, but with a slight bend downwards at the tip of the upper mandible. The tomia margined but without any notch. The nostrils at the base of the bill, of an oval shape, and without any valvular or protecting membrane, but in part covered with feathers projecting to the front. The feet have three toes before and one behind; the outer toe joined to the middle one at its base; and the tarsus as long as the middle toe. The foot is thus much more of a perching than a walking foot. The wings are long and pointed; the first and second quills being the longest. The most peculiar character of the bird, and that which has procured it the name of *waxwing*, is the way in which the ends of the secondary quills are terminated. These have the tips of their shafts extended into little discs of soft horny substance, which appears as if that part of each feather had been dipped in sealing wax; but of what use these little balancers are to the birds in their flight, or in any other part of their economy, is not known. But this loading of the points of the feathers must render the wing a little stiffer against an oblique strain at that part; and this may be necessary, as the birds are very discursive in their habits.

As there are only two species of the genus,—the Bohemian waxwing (*B. garrula*) and the Carolina waxwing, (*B. Caroliniensis*), we shall combine what general observations we have to make on the habits and economy of the genus with our notice of the first of these species.

BOHEMIAN WAX-WING (*B. garrula*). Neither of these epithets are very applicable. The birds do appear in Bohemia, but they appear there only as visiters; and they might with equal propriety be named after any of the countries near the Baltic, and more especially after Sweden, where they are found in greater numbers, perhaps, than in any other part of Europe. As little is the word *garrula* descriptive of them, for they are rather silent than otherwise; and the name appears to be continued from that of chatterer at the time that this genus was confounded with the true chatterers (*Cotinga*).

These birds are never long in one place; but they are discursive rather than migrant, and upon the continent they do not resort annually to the same places, or at the same times of the year. Of their nesting places or resorts where they breed not much is known; and they are accordingly one of the genera which the continental naturalists are very often in the habit of "sending to Siberia," to construct their nests and perform their incubations. That many birds resort to Siberia, and also to the northern parts of Russia, as well as to the Scandinavian peninsula, during the summer months, is not only probable, but certain; for the summer there is proportionally as warm as the winter is cold, and it sets in so late that by the time there is temperature sufficient to entice a bird to the country, there is light sufficient for it to find its food during the greater part, and even the whole of the twenty-four hours.

In these northern places, which are either not inhabited at all or very thinly so, and which, being flat, are humid in the yearly part of the summer, abound much more in the food of birds than places further to the south, where the climate is upon the whole milder, and the seasons much more uniform. Insects and the smaller ground animals, which hybernate in the earth below the reach of the frost, which penetrates to a much smaller depth in proportion than when the earth is not protected by a covering of snow, are not only very numerous in those parts, but there is a more ample provision of food for birds than one would be apt to suppose. Even the mammalia, such as the bears (see BEAR), which remain in these high latitudes during the winter, have a tendency to accumulate more fat than the races, or even than individuals of the very same race which winter in warmer climates—so admirable are the constitutional tendencies of all creatures tempered to that state of the elements under which they have to exist.

But this law of adaptation in nature runs through all those productions in which the vital or the growing action has to be preserved through a dormant period of severity, whether that severity arises from cold, as in the climates more immediately under consideration, or from drought, as in tropical countries. In these northern latitudes, the trees make more perfect and also what we may, without impropriety, call "fatter" buds than they do in temperate climates; and they evidently do so because the germ or more active part of the bud requires the protection of a more thick and close hybernaculum, and because the more rapid action which these buds make when the summer calls them at once into action, with the intervention of little that can be considered as spring, demands a greater store of prepared materials. Thus there is upon these plants two crops of food for the tree birds—one of the hybernating bud on the early shrub; and the other of the seed when it is ripe, or of the pulp of the berry in other cases. The evergreens, the pines for instance, form no exception to this; for though they retain their leaves during the winter, their buds are as well prepared, and as closely moulded up as those of the trees, or rather the shrubs (for there are few deciduous plants which deserve the name of trees in those latitudes) which are denuded of their leaves.

This peculiarity of the polar forests forms so important an auxiliary in the history of those birds which resort thither, and the wax-wing of the Eastern continent is in its very irregular wanderings so intimately connected with the seasonal character of those forests, that this seems to be the fittest opportunity for offering one or two short remarks on them;—and this is the more necessary that the habits of these birds have never been very satisfactorily explained, and this apparently for no other reason than that the seasonal characters of those places to which they retire when they quit the more cultivated places, have not been considered along with them. This indeed has been the grand fault or imperfection of the study of nature in all its kingdoms and departments: one has attended to the animal kingdom, or even to one department of that kingdom; another has attended only to the vegetables; and a third has confined his observations and his investigations to the climate and the seasons; but no one has brought them together, and stated the manner in which it should be done for the proper and satisfactory understanding of any one of them, the general analogies which connect the three, or the general law which they all obey. They have, as hinted, "sent the bird to Siberia," and so got rid of any further trouble with it, as is the object of sending to Siberia in other cases. But they have not told us what the bird does in Siberia, or what entices it there; for it is enticed, not forced, and goes there in virtue of the *ukase* of nature, and not of any human autocrat. Now, why it should go to Siberia is the grand point of the case, the one upon which information is especially desirable, because it is in this that we discover the true character of the bird; and as we need the character of Siberia, in order to determine that, we make out the entire case; whereas if we content ourselves with merely stating that the bird goes there, we have only half a case, which we are of course unable to use as an analogy, and so the labour which we have taken is lost.

It is easy to answer, generally, that the bird goes to Siberia evidently because Siberia is the place best suited to its habits; but it is in the characters which so suit it that the information lies. Now many of the birds which summer in the arctic lands are insectivorous, or otherwise animal feeders; but the greater number of these are ground birds, and many of them have habits wholly or partially aquatic. Still, there are others which are in these northern climates for a larger portion of the year, which are chiefly vegetable in their feeding, and which are rather tree birds than perching birds; and they do not resort so regularly to the temperate latitudes as the others. The crossbills belong to this class, but they (see BIRD and CROSSBILL) have their bills of so peculiar a construction, that their locality in these northern places can be much more easily ascertained than those of such a bird as the wax-wing.

That the birds which resort to those regions in the summer to consume the vast surplus of life which is in and near the waters, should not seek their way there till the summer is considerably advanced, and that they should quit them again early in the autumn, we can readily understand, as the frost is long in giving way and returns early; and during its continuance the more aquatic grallidæ are frozen out (much longer of course than the swimmers, and longer still than the divers) and the insects perish or disappear. We know the habits of those birds in other countries, and thence we infer, with a reasonable degree of certainty, what it is that entices them to the north; but the wax-wings and other tribes analogous in habit, and on that account probably much more analogous in their general characters than their present places in the system would lead us to believe (for the place of the wax-wing in the system is far from being natural or satisfactory), make their appearance so irregularly in the southern parts of their range, and, though they appear there in considerable flocks, are so much fewer than they are in places further to the north, and in the immediate vicinity of those polar forests, or combinations of forest and marsh, which have been mentioned, that they may with much more propriety be said to be driven from the polar countries than enticed to them. And thus, before we can have any satisfactory knowledge of their characters, we must know something about the general economy of nature in those places.

Now, as we have mentioned that all the ligneous plants of those polar climates, whether they come under the denomination of trees or of shrubs, and whether they be deciduous or evergreen, form fatter buds, or buds containing more farinaceous or albuminous matter than those of milder climates. Those which grow to trees are for the most part evergreens, of the natural order *Coniferæ*, and generally speaking of the pine family; and their leaves worn all the winter are of great importance to every kind of life, on account of the shelter which they afford. Indeed where these evergreens are not found (for the deciduous plants are few in number, and they appear only in low and sheltered places), the storms when winter sets in, and the winds when it breaks, are so violent that the surface is scourged to barrenness, and there is hardly food even for a bird; so that in those high latitudes the pines are, in an eminent manner, the protectors of life and the preservers of fertility—such fertility as is to be found there.

And it is well worthy of observation, how very beautifully the coniferous trees of those regions are adapted for abiding the frosts, and protecting all those living creatures of which they are the shelter. Their roots have not a tendency to penetrate very deeply into the earth, for the soil is usually but thin in those places; but they extend to a very considerable distance laterally, so as to afford a broad, and therefore a stable base; and the bole of the tree rises in one straight cone, gradually tapering to the top, and thus increasing in strength as there is more strain upon it from the action of the wind. The branches too, have the same tapering and spiry out-lined ; and the leaves though closely set, and thus forming a thick shelter, are in their individual forms narrow and needle-shaped, so that they offer little resistance of surface to the wind ; and they are stiff and smooth, so that the wind takes but little hold on the surfaces which they present. Those of more lowly growth again, such as the junipers, which are a little more branched in their general form, are still spiry in their outlines, and their timber is both tough and flexible. The fruit, too, upon those plants, of more than one season's growth before it comes to maturity, affords food when that of the more seasonal bushes is gone ; and thus, what with buds, what with the seeds of fruits, what with berries, and what with young shoots (for those of the pine are eatable by man, and even agreeable to the taste), the vegetable feeders of those dreary climates,—though dreary only in the winter months, for in summer, they are the lightest and most gay on the surface of the globe,—find food when all the animal feeders, except those which depend on the sea, or feast on the flesh of their fellow birds, must retire to the south.

There is no question that the Bohemian wax-wing (for we must call it "Bohemian," however faulty the name may be,) belongs to those vegetable feeders ; and as it is much better winged, and more discursive in its range, than the cross-bills, the crested wrens, and some other races which inhabit the pine forests closely for the greater part of the year, we may suppose that it annually takes its range of all the kinds of vegetable food which present themselves in the succession of the seasons.

When it comes into Britain it is only in the winter, and during very severe storms; and then the birds do not appear as stragglers, but in large flocks distributed over a considerable part of the country, as if the whole colony had, by a storm still more severe, been driven *en masse* from a more northerly habitation. In 1810, they were numerous in some parts of the island ; none made their appearance for about twelve years afterwards ; and there is no account of their appearing in any considerable numbers ever since, though a few have occasionally been observed. When in this country their food is chiefly those wild berries which remain on the trees in winter, and become more mellowed and also more farinaceous after they have been touched by frost ; such as the berries of the common hawthorn and the mountain ash. Of course the birds perch when feeding upon these, and when with us they have been usually seen on the wing or on the perch, and rarely upon the ground.

In the countries immediately south of the Baltic, they are much more frequent and numerous ; but even there they are not so plentiful as in Sweden, where they are represented in such flights as absolutely to darken the air as they pass. This very numerous appearance in the southern part of the Scandinavian peninsula, very naturally leads to the conclusion that they are dispersed in the more northerly parts of the same country during the breeding season. From these particulars of its locality, and especially from its appearing in Bohemia only as a visitant (for there is no account of its having remained to breed in that country), it would, perhaps, if there were not some objection to the changing of a name however inappropriate, be better to call this species the *common* wax-wing (*Bombycilla vulgaris*), and it might not perhaps be amiss to alter the specific denomination of the other to American (*Americana*).

The common wax-wing is a very beautiful bird, of handsome shape and richly coloured. The male is about three ounces in weight, and between eight and nine inches long. The female is rather smaller.

Bohemian Waxwing.

The flesh of both birds, when in good condition, is highly esteemed. The bill is black at the tip, passing into pale whitish straw colour at the base ; the nostrils covered with slender black feathers which incline forwards. A portion round the eyes, and the chin and throat, are deep velvet black. Forehead and top of the head reddish brown ; the feathers on the crown being long and silky, and forming a sort of short crest, which is loose and pendent, and more rich in the colour, and inclining to purple, than the short feathers on the forehead. The neck, upper part of the back, and breast, are of a peculiar colour, which is very soft and beautiful, but not easily expressed in terms of any single colour having a name ; it partakes of brown, purple and grey, blended into an entire tint, and blended so equally that one cannot easily say which of the three predominates ; and it is not mottled, even in that minute way which produces these colours which change in different lights, but one full colour showing always the same. This colour is continued upon the scapulars and lesser coverts, but of a darker shade and partaking less of the grey. The greater coverts are black with white tips. The primary quills are black, with the outer webs white, and a bright spot of rich yellow on the white part of each near the end. The secondaries are grey, with white tips to the outer webs, and seven or eight of them have their shafts enlarged at the ends (beyond the webs) into red discs, which have very much the appearance of sealing-wax. The lower part of the back and the rump are smoke-grey with a reddish tinge, the tail feathers black with rich yellow tips. The under tail coverts and vent feathers are reddish orange-brown ; and the belly and breast purplish-red of a very pale and somewhat brownish tint. The irides of the eyes are purplish red ; and the tarsi, toes and claws black.

The female has nearly the same markings as the male ; but it is smaller in size ; the yellow on the wings and tail is paler, and the wax-like appendages to the tips of the secondary quills are smaller and not so numerous.

The wings and tails of those birds, when spread out, have a very fine appearance, from the contrast of deep black, pure white and bright yellow which they display; and the richness is farther increased by the very peculiar appendages, which are quite solid and shining, and unlike any thing that forms part of the feathers of any other bird. The whole plumage is indeed remarkable for its velvety texture, and the glossless purity of its colours; and though the birds visit us but seldom, and at inclement seasons, when they do make their appearance there are very few of our birds, whether native or visitant, that display so much beauty; and therefore it is highly desirable that something more of their manners were known.

Wild and erratic as the wax-wings are in a state of nature, they are tamed without much difficulty; and they appear to be of a mild and gentle disposition. But although they are passive under the captivity of the cage, their nature cannot bear up against a restraint so cruelly contrary to their native habits; and they very soon fall victims to the senseless cupidity of their gaolers. The sufferings of most birds in that state should plead powerfully with all who can feel for animal suffering, for the abolition of a custom which inflicts pain upon a very beautiful and interesting race of creatures, without having even the consideration of pecuniary profit to plead in its defence.

American Wax-Wing (*Bombycilla Americana*). There is much difference in size and colour, and no inconsiderable difference of habit, between this bird and the wax-wing of the old continent; but it has the external characteristic upon which the name is founded, namely, the enlarged discs of a substance in colour and gloss resembling red sealing-wax, at the ends of the shafts of the secondary quills. Besides, though the habits of the bird are different, we must bear in mind that there are great differences between

American Waxwing.

the country which it inhabits, and that which is inhabited by the other. On the old or eastern continent the coniferæ which have pulpy or succulent cones, at least which have them so much so as to come under the denomination of *berries*, are few and thinly scattered. They are only, or chiefly, the common yew and the common juniper, the first of which is no where very abundant, and the second is merely a shrub; so that the autumnal feeding of the wax-wings is in a great measure confined to the berries of the vacciniums and other lowly shrubs of the extreme north. The birds depart at that season into the swampy wilds where these are produced; and as there is not there much to tempt the foot of ordinary enterprise to visit such places, and as the places are difficult and even dangerous, the birds remain in undisturbed possession; and neither the time nor the mode of their nidification is known. It is indeed by inference from what is known of the American species only, that we can arrive at even a guess at the general economy of the European wax-wings, though they sometimes present themselves to us in considerable number, and though the flights of them in Scandinavia are probably to the full as numerous as those of any other European birds. From what is known of the American wax-wings, we may conclude that the European ones breed late in the year, after the summer solstice, and when the berries on the northern morasses are beginning to ripen. And we have some collateral proofs, or presumptions, that such must be the case in birds which visit nearly the same localities in the breeding time, and in others which reside more permanently in the neighbourhood. Turnstones, and various other shore birds, which linger with us till the season is far advanced, breed in great numbers on the islands along the coast of Norway and Lapland, and though it is not proved that these are the identical individuals which linger with us, yet it is probable that they are, as they have not hitherto been found breeding in any nearer locality. The cross-bills again are said to breed in the polar forests in the winter, in that depth of the season when both earth and tree have a mantle of snow, and the birds are sheltered from the air and concealed from observation. The time of the year in which cross-bills appear as migrants in the south favours this theory; which is farther confirmed by the fact that all birds pair at that season when food is most abundant for themselves and their young.

It is in the American forests and the American wax-wings that we have the most satisfactory analogies; and though these are analogies of difference, not of similarity, they are not on that account less efficient for the discovery of the truth, for an analogy of contrast is often as good as one of coincidence, and sometimes better. Now, the evergreen coniferæ of America, with pulpy cones, or berries, extend through all the middle latitudes of that continent, that is, from near the confines of Canada, where they inosculate with the pine forests, following the swamps, while the pines are on the dry *barrens* (so called, because grass does not grow under pines), to the northern confines of the Floridas, where they begin to give place to the deciduous taxodium. These berry-bearing coniferæ are popularly called "cedars," but they are not; they are junipers, only having the habit of tall and spiry trees, and from this habit forming perhaps more closely covered forests in the swamps than are to be found in any other part of the world. On the first settlement by European colonists, these cedar swamps occupied a great breadth of the country eastward to the shores of the Atlantic, but they have since been nearly extirpated in the whole range between the Apalachian ridge and the sea, with perhaps somewhat more zeal than wisdom, as building-timber begins to be scarce and costly even in that land of former forests. On the west side of the mountains those trees are, however, very abundant still, and as they bear a vast multitude of berries, the number of birds which find their food upon them, when these berries are in season, is beyond all precedent which we have on this side the Atlantic.

There is thus no need for the same extent of northward and southward migration on the part of any of the forest birds of America as there is in those of the eastern continent; and in the case of the wax-wings, which seem tempered to much range of climate, the necessity of migration upon a meridian is almost entirely removed, by the abundance which they find in the berries of those junipers in the winter, and very early part of the spring, and in the hill berries, over a very considerable extent of latitude (over the whole range, indeed), as the season advances. Accordingly, the wax-wings there are found all the year in nearly the same latitudes, only they are among the junipers of the swamps when the berries of these are ripe; and when this supply fails they are forced to range in quest of other food.

The early part of the season, which is the time of plenty and of song with the birds of the deciduous groves, is with these wax-wings the season of want, or, at all events, of penury. By that time the berries of the junipers, which afforded so abundant a supply in winter and early in spring, begin to be exhausted, and the few that remain are dry and shrivelled, and contain little nourishment. The birds are in consequence obliged to make out their subsistence with insect food, and the insects which they eat are said to be beetles; but that species of food does not appear to be very congenial to them, as they are lean and in bad condition at those times when they resort to it; and it is not till the early berries are ripe on the hills, and the early cherries, and other small pulpy fruits in the orchards, that they begin to disperse over the country, and commence the grand labour of the year.

According to Wilson, than whom there have been few observers of wild nature more true in all the minutiæ, or more graphically delightful in the general effect, these birds are very lean and low-spirited in May, the period when most of the tenants of the groves are in the very strength of their energy and the fulness of their song. In June their favourite forests begin to ripen, they fatten apace, and before the middle of that month the building of the nest is begun. The nest is placed in the fork of a tree, wholly composed of vegetable matter, coarse grass on the outside, and finer within, and it is large for the size of the bird. The eggs are four, of a dull bluish white, tapering much toward the small end. The greater part of it is dropped over with small blackish spots, but there are some purple blotches on and near the thick ends. The incubation is understood to last for about twenty-one days, so that the young break the shell about the end of June. They are fed at the first upon insects and larvæ, but afterwards upon leaves and succulent fruits.

This midsummer dispersion of these birds cannot be considered as a migration, because some of them remain in the near vicinity of the houses, and also in the cedars on the swamps, which still afford them sufficient concealment for their nests, though not food; but there are many insects in those places for the young in their early stage, and a little later there are generally berries on the margin of the swamp. On these low-lying places this species of food is nearly exhausted by the time that the bilberries, and other succulent fruits on the hills, are ripe. The birds, with their broods, retire to those mountain pastures about the end of July or the beginning of August; and by the end of September their harvest on the hills is about over, and they return to the low grounds, the tree berries on which are then beginning to get ripe; on their return they assemble in small packs, but they are never found in such clouds as the common wax-wings are.

Thus, though these birds occupy a more southerly latitude than the wax-wings of the eastern continent, and one which is very different in its climate and vegetation, there is, making allowance for these differences, no inconsiderable resemblance in the habits of the two species; so that, from the known history of the one, we may, in part at least, infer the unknown part of the history of the other with regard to time and manner of nesting, number of eggs, and various other particulars. The fact of the eastern ones being more discursive in the winter months obviously depends on geographical causes—the depth of the snow sometimes cutting them off from all supply of food in their northern haunts, which is not the case in the cedar (juniper) swamps of the central latitudes of North America.

In the size, the wings, and the colours of the two species, there are considerable differences. The American bird is by much the smaller of the two, and it is less powerfully winged than the other. This may be inferred from the different characters of the places in which they reside, and the necessity which the eastern one is under of ranging to greater distances in severe weather. But the two species agree with each other, and differ from the chatterers (*cotinga*), with which they have been confounded, as being very silent birds, so much so, that the American species, which is the one of which anything is known during the pairing time, does not sing or make any more noise then than at any other season. The following is the substance of Wilson's description of the American bird:—

"Length, seven inches; extent of the wings, eleven; head, neck, breast, upper part of the back, and wing coverts, dark fawn—darkest on the back and lightest on the forehead; head with an upright pointed crest; line from the nostril over the eye to the head, velvet black, with a white line on its upper margin, and another extending from the lower mandible; the chin black, passing gradually into fawn, and the feathers remarkably close; wings deep slate colour, except the two secondaries next the body, which have their exterior webs fawn, and their inner ones white, six or seven, and sometimes the whole nine secondaries, with the enlarged wax-like appendages at the ends of their shafts. These do not appear on the young birds till the second autumn; they are common to males and females, though generally less numerous on the latter; and there are instances of their being on the ends of tail feathers also. The rump and tail coverts are pale blue, and the basal portion of the tail feathers is the same, but on these it passes into deep black, which is terminated by about half an inch of bright yellow at the tips. The belly and vent feathers are white. The bill is black, the upper mandible triangular at the base, rounded toward the tip, slightly bent there, and deeply notched; and the upper one is scalloped and slightly turned up. The inside of the gape (which, as well as the gullet, is wide) is orange, the irides are dark red, and the feet and claws black. The sexual difference in colour is: the tints of the female paler, the yellow on the tip of the tail not so broad, and the crest on the head less produced and elevated."

Some circumstances mentioned by Wilson tend to throw light upon the very irregular appendages in which the secondary quills of the wings of these birds terminate. He remarks, that he found those feathers which had not the wax-like appendages always rugged at their tips, and broken and ruffled for some part of their webs, but that the ones with the appendages were entire and unruffled. Thence it follows that these appendages act as a protection for the more delicate part of the feather, and this unusual provision for the safety of that member must, according to the universal law of nature, be made for the purpose of providing against an unusual exposure to injury.

This brings us very naturally to the principal habit of the birds; that is, to the character of the plants upon which they find the greater part of their food; these are, in both continents, the junipers and vaccinIums, both of which, but more especially the former, have the leaves very stiff, slender, and sharp pointed; and as the leaves are borne on the exterior surfaces of the trees, the spiry parts of which are not easily penetrated by any bird, and further, as the birds have to range the surface of the spiry tree while they collect this food, they are in a situation in which they cannot have a very firm perch by the feet, though their feet are well adapted for perching (and, by the way, should, independently of other circumstances, take them out of the class of omnivorous feeders). They must thus, in order to maintain their stability, always have the wings ready, and in general spread; and as in this spreading the secondary quills come into frequent, indeed almost constant, contact with the stiff, pointed, and needle-shaped leaves of the trees and bushes on which they find the berries, these little "fenders," as we may call them, at the end of the shafts, afford a very efficient protection to the webs of the feathers.

Thus we find, in these birds, an adaptation which is peculiar among the many and wonderful adaptations of which the feathered tribes afford instances. This adaptation accords with the vegetation of a very peculiar part of the world, whether we look to the eastern continent or to America; and therefore the wax-wings acquire an importance in the eyes of the student of nature to which they would not be entitled in their ordinary character of handsome and finely-coloured birds.

It is this circumstance which has induced us to consider them at greater length than we can, in general, afford to consider a genus of which the known species are so very few. But in those very typical birds which connect themselves strongly with localities that are fitted to the growth of only one remarkable species of vegetation, there is far more in the bird than a mere bird's history; and if we did not avail ourselves of the opportunity of opening a little the general history of nature, and showing the harmony of the parts, and their connection with each other, when the subject of which we are more immediately treating offers itself as a key, we should feel that we were failing sadly in our duty to the public.

In our continent the wax-wings are at home only in places situated far to the north; and though, in America, they range more southerly, that can be easily explained from the physical differences of the two countries, which carries the appropriate food of the birds into regions farther to the south. So far as discovery has hitherto gone, there are no birds of similar structure and character in the high southern latitudes; indeed, there is no vegetation adequate to their maintenance. The extreme south of Africa, and that of America, have more of a tropical character than, reasoning from the latitude, one would be led to expect; and though, in Australia, there are some families of plants, such as *Lissanthe*, which appear to answer, in some sort, to the vacciniums of the northern hemisphere, yet they are plants of different character, not so productive of berries, and the berries on them are not so succulent.

BOMBYLIIDÆ. A family of two-winged insects (Diptera) belonging to the section *Tanystoma* of Latreille, having for its type the genus *Bombylius* of Linnæus, with which in fact it nearly corresponds. It is characterised by the great length of the parts of the mouth, which are very slender, and united into a porrected proboscis. The body is thick, short, and very hairy; the head affixed in a low position on the thorax, the latter is very gibbose; the wings are horizontally extended on each side of the body, with the halteres exposed; the antennæ are short, and inserted near together; they are composed of three joints, of which the last is the longest, and thickened, terminating obtusely. The legs are long and very slender. These insects are very active, flying with the greatest rapidity. They hover over flowers without settling upon them, introducing their long proboscis alone, in order to extract the honeyed fluid which they contain, and which forms the sole food of these insects. Their transformations are unknown; Latreille, however, presumes that they are parasitical in the nests of other insects. The perfect insects are to be met with in fine weather, and during their flight they make a humming noise like that of the drone flies. They delight to take their station in the sunny corner of a lane or other similar place, where they hover hawk-like for a great length of time without moving from the spot; on approaching them they dart off and re-commence hovering at a little distance. They are nearly allied to the *Anthracidæ*.

The insects comprised in this family are not numerous, they are of small or but moderate size, and are for the most part exotic. The genera are *Toxophora*, *Xestomyza*, *Apatomyza*, *Usia*, *Phthiria*, *Bombylius*, *Geron*, *Thlipsomyza*, *Ploas* and *Cyllenia*; of these the genera *Bombylius* and *Phthiria* are British. The former has the proboscis very long, the palpi distinctly visible, the second joint of the antennæ very short, and the third or terminal, joint long The body, which is short and thick, is covered with hair, which gives these insects the appearance of bees, whence they have been named bee-flies. The genus comprises seven or eight British species, of which the *Bombylius major* of Linnæus is one of the commonest species. It is about one-third of an inch long, and covered with dirty yellowish hairs; the outer half of the wings is dusky, the remainder hyaline. Another species inappropriately named by Linnæus, *Medius*, (since it is larger than the *B. major*) has the wings marked with small dark spots at the junction of the nerves. It has been figured by Mr. Samouelle in his Compendium, pl. 9, fig. 10, who has increased the confusion by calling it *B. major*. A third species, *B. minor*, Linnæus, is much smaller than either of the foregoing, with clear wings. The genus *Phthiria* has a much narrower body, and shorter proboscis. The type is the *Bombylius pulicarius* of Mikan, figured by Mr. Curtis in the last number of his British Entomology, for October, 1834.

By Geoffroy these insects were confounded with the genus *Asilus*, with which they are allied in some degree; and as the article upon that group was accidentally omitted in its place, it may be convenient, for the sake of pointing out the differences between the two families, to introduce it in this place.

Asilidæ (Leach). A family of insects of the order *Diptera*, the type of which is the Linnæan genus *Asilus*. These insects, which are very voracious, have the proboscis exposed, but not longer than the head, with very small terminal lips; the body long, the wings recumbent upon the body, and the antennæ composed of three joints. They are to be found in fields, gardens, and the borders of woods, towards the middle of summer. They fly rapidly, especially in the hot sunshine, and make a loud buzzing noise. They prey upon other insects, which they seize whilst on the wing, by means of their fore legs, and extract their fluids by means of the four fine lancet-like pieces contained within the mouth.

The larvæ reside in the ground; they have the body long and twelve-jointed, a scaly head furnished with two moveable and bent hooks; they are destitute of legs, but make use of the hooks of the head to seize hold of the substance upon which they are placed, so as to enable them to draw their body along. They undergo their transformations in the situations in which they have lived whilst larvæ, where they change to nymphs; yet although they quit the skin of the larvæ, they do not form a cocoon in which to change to pupæ. The duration of their existence in this state, as well as in that of the larvæ, is unknown. The family comprises the genera *Laphria*, *Asilus*, *Ommatius*, *Dasypogon*, *Dioctria*, and *Gonypes*. Of all the genera, with the exception of *Ommatius*, we possess British examples. The indigenous species of *Asilus* are numerous and very ravenous; one of the finest species is the *Asilus crabroniformis*, so named from its resemblance to the hornet; we have met with it in Battersea fields. It is represented in Samouelle's Compendium, pl. 9, fig. 9.

BOMBYX (Linnæus). A genus of lepidopterous insects, forming, in his system, the second of the eight divisions into which the *Phalenæ*, or moths in general, were divided, and characterised by the wings being incumbent, and the antennæ feathered; the first of these divisions comprised the *Attaci*, (which see). The investigation of this order of insects has, however, been greatly advanced since the days of Linnæus; and although Mr. Haworth, in his celebrated work, the "Lepidoptera Britannica," united the Linnæan *Attaci* and *Bombyces* into one genus, *Bombyx*, yet more recent authors have not only kept them apart as genera, but have separated the *Bombyces* into two families, namely, the *Arctiidæ* and *Bombycidæ*, in the latter of which the genus *Attacus* has been placed; and in the latest works upon this subject, a third family has been separated from the *Bombycidæ*, under the name of *Notodontidæ*, composed of the *prominent* moths, &c. These three families, together with that of the moths termed swifts and goat-moths (*Hepialidæ*), form a great division of the nocturnal *Lepidoptera*, to which the ordinary name of feathered full bodies is applied by collectors, from the large size of the body, and the feathered antennæ.

In Mr. Stephen's work on British Entomology, they form a section which he has termed *Lepidoptera pomeridiana*, in consequence, as he states, of many of the *Bombycidæ* commencing their aerial excursions in the afternoon, when they may be observed flying with great velocity, and describing large undulated tracts in their course. These four families may thus be briefly characterised.

Family 1. *Hepialidæ*. Antennæ generally moniliform or setaceous. Spiral tongue obsolete.

Family 2. *Notodontidæ*. Tongue (maxillæ) evident, but very short.

Family 3. *Arctiidæ*. Tongue evident, but not elongated.

Family 4. *Bombycidæ*. Antennæ bipectinated. Spiral tongue obsolete.

It will be seen from these characters, that the second and third families are separated by very slight distinctions, and we accordingly find entomologists at variance as to the limits of the groups. Our arrangement corresponds with that of Mr. Stephens, with the addition of the exotic genera inserted in their proper situations. We shall here only observe, that the footmen moths (*Lithosiæ*), which Latreille places amongst the *Arctiidæ*, are removed by Mr. Stephens to the *Lepidoptera nocturna*, and that in his last work, the puss moths (*Ceruræ*) were formed by Latreille into a distinct section, to which he gave the name of *Aposura*, (tail without feet) from the larvæ having no anal prolegs.

The families *Hepialidæ* and *Notodontidæ* will be described in their alphabetical places, but the article on the *Arctiidæ* having been accidentally omitted, it is here inserted.

Arctiidæ (Leach). A family of Lepidopterous insects, separated from the great Linnæan division *Phalæna Bombyx*, and nearly corresponding with the section of nocturnal moths, termed *Pseudo Bombyces* by Latreille, with the exception of the prominent moths (*Notodonta*) which, with a few others, have been formed by Mr. Stephens into his family *Notodontidæ*. The species introduced into this family are of very diversified habits and structure, and general characters alone can be assigned to them. The antennæ are generally more or less strongly feathered, especially in the males, the bodies somewhat robust, and the wings large and entire; when at rest, they are either deflexed or placed in a horizontal position. The spiral proboscis, so striking a character of the *Lepidopteræ*, is here so slightly developed, as to be incapable of performing the duties of a tongue, and is indeed occasionally completely obsolete. The palpi are also generally of small size.

The extremity of the body of the males is generally tufted, and that of the females covered with a woolly mass, which at the period of oviposition, is detached from the body, and serves as an envelope for the eggs. The caterpillars feed on the external parts of various vegetable productions; they are generally very hairy, and often ornamented with coloured tufts of hair along the back. The chrysalides are generally enclosed in a web.

In this family there appear to be several distinct groups, each of which is divisible into various genera.

The first of these divisions has the wings proper for flight on both sexes, the tongue almost rudimental, and the larvæ elongate, and not forming tents. Here belong the genera *Hypogymna* (the gipsey moth), *Psilura* (the black arches), *Dasychira* and *Demas* of Stephens (or the tussock moths).

In the second division the females are destitute of wings, and the caterpillars have large tufts of hairs on the neck. The only genus in this division is *Orgyia* (the vapourer moths).

In the third division the wings are more or less transparent, and the tongue distinct, scarcely longer than the head. Here are to be placed the genera *Lælia* and *Leucoma*, or satin moths, *Porthesia*, Stephens) *Arctia* of Curtis), or the brown and yellow-tailed moths, and some other genera.

In the fourth division the wings are thickly covered with scales, and the tongue, as in the last division, to which belong the ermine moths, *Spilosoma*, Curtis, the tiger moths, *Arctia*, Schrank and Stephens, and some other less interesting genera.

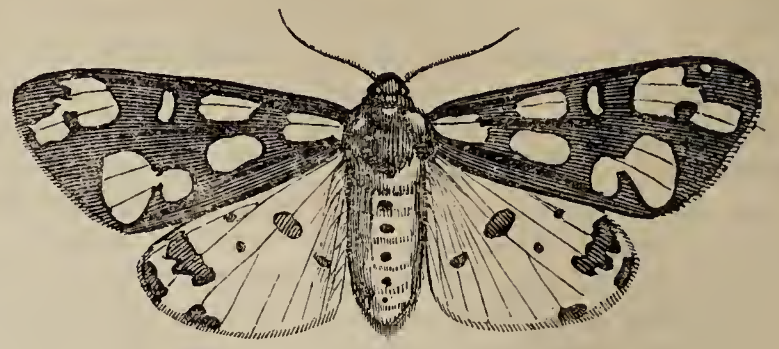
In the fifth the larvæ resemble wood-lice, without legs, and the antennæ of the perfect insects are simple, consisting of the two singular British genera, *Heterogenea* (Knoch), and *Limacodes* (Latr. *Apoda*, Haworth).

In the sixth the larvæ reside in portable cases of their own construction, the moths are destitute of a tongue, and the antennæ strongly feathered in the males; the wings appear to be clothed with hair rather than scales. There are three genera. *Psyche* (Schrank), *Fumea* (Haworth), and *Penthophera* (Germar).

In the last division (which are most nearly allied to the next family, *Lithosiidæ*, in which it is placed by Mr. Curtis), the antennæ are but slightly pectinated, the wings broad, and the tongue longer than in any of the preceding divisions. It includes the muslin moths (*Nudaria*, Haworth), as well as the scarlet tiger moths (*Hypercompa*, Stephens).

The natural history of many of these moths, which are amongst the most beautiful of the nocturnal lepidopterous insects, is very interesting, and will subsequently be detailed under the heads of the more prominent genera. Great confusion has originated in the generic nomenclature of the different groups of these moths, more especially in the works of Schrank, Stephens, Ochsenheimer, and Curtis. We have, however, adopted the views of the two former authors, by giving to the tiger moths, which appear to be the types of the family, the generic name of

ARCTIA (*Eyprepia*, Ochsenh. and Curtis. *Chelonia*, Godart). A name indicative of the hairiness of the caterpillars, which in some parts of England are thence termed woolly bears. The beautiful insects comprised in this genus were amongst the first to attract attention of our boyhood to the study of insects, and the most casual observer of nature cannot have failed to notice them from their common occurrence. The body is robust, and the abdomen transversely striped with different colours; the prevailing tints of the upper wings are rich brown, with white markings, and of the lower bright crimson, with shining blue-black spots. The caterpillars of the common species, *Phalæna Bombyx Caja* of Linnæus, are solitary, of a dark brown colour, thickly clothed with hairs arising from fleshy tubercles in the middle of each ring of the body, the hairs at the sides being reddish. They are hatched in autumn, and come forth in the spring, feeding upon various plants, especially lettuces and chickweed, and change to chrysalides in June, the moth appearing about the end of July. This species, which is the garden tiger moth, is very common. The cream spot tiger (*Arctia villica*) is smaller and less common. The small tiger (*Nemeophila plantaginis*), and the ruby tiger (*Phragmatobia fuliginosa*), which seldom exceeds an inch and a half in expanse, are rare near London, but seem to be more common in the north of England.



Cream-spot tiger.

The remaining family *Bombycidæ*, comprises some of the most valuable of the insect tribes, since the silk-worm is the larvæ of one of the species. The tongue in this family is either very short and flat, not spiral, or entirely obsolete; the wings are either horizontally extended, deflexed or reversed, and the antennæ are strongly pectinated, especially in the males. The want of an oral apparatus is the more remarkable, because some of the species are amongst the largest lepidopterous insects. Their habits are diversified and very interesting. The larvæ are naked, with sixteen legs. They spin a cocoon of pure silk. The pupæ are destitute of minute hooks on the sides of the body. The family comprises three primary divisions. 1. Those with horizontally extended wings, furnished with eye-like hyaline spots, consisting of the genera *Attacus* and *Aglia*. 2. Those with entire wings, and with the palpi not advanced in front, comprising the silk-worm moths, to which we restrict the generic name of *Bombyx*, the egger and lackey moths, (*Lasiocampa* of Schrank, but not of the Regne Animal) *Eriogaster*, *Clisiocampa*, and some other genera, and 3, those with porrected palpi, and denticulated wings, consisting of the lappet moths, *Gastropacha*, *Dendrolimus*, and the drinker moths, *Odonestis*.

The history of *Bombyx mori*, the silk-worm, will form a separate article under its English name, and the more remarkable of the other genera will be found in their respective places.

BONAPARTEA (Ruiz and Pavon). A rush-leaved herbaceous plant, native of Peru. Class and order *Hexandria Monogynia*, natural order *Bromeliaceæ*. It is a plant of no beauty, hardly deserving a place in the hot-house.

BONATEA (Willdenow). A handsome orchideous plant, native of the Cape of Good Hope. The flowers are said to be splendid.

BONNETIA (Schreber). A genus of one species of an ornamental tree, native of Trinidad. It belongs to the class and order *Polyandria Monogynia*, and to the natural order *Guttiferæ*. Its specific name being palustris, would indicate that the tree affects wet ground; and from its connection with other genera of great importance, implies that it may be possessed of valuable properties not yet sufficiently known.

BONUS HENRICUS (Linnæus). *Anglice*, Good Henry, is the *Chenopodium bonus Henricus* of botanists, a common plant found growing in rubbish about old buildings. Why it should have obtained such a name is not easily surmised; unless it be that it sometimes furnishes the cottage table with a dish like spinach, when no other greens, perhaps, can be had.

BOPYRUS (Latreille). A curious genus of crustaceous animals, which is parasitic upon prawns, causing a large swelling upon the sides of the bodies of those animals. The body is oval, flat and soft, having an elevated line beneath, with various transverse impressions; the abdomen is narrower than the body, flattened, and with similar impressions; there are seven pairs of legs placed at the side of the body, but very short and bent. The body is also furnished beneath with four pairs of longitudinal plates, serving as a sort of oviferous pouch. The type is the *Bopyrus squillarum* of Latreille (*Monoculus Crangorum*, Fabricius). It is one-third of an inch long, and must be very obnoxious to the prawns, which it infests; one, however, only attaches itself to each prawn, but it is found in this situation at all times of the year. It is a vulgar opinion among fishermen, that these parasites are young soles, which notion was even recorded by Deslandes in the Memoirs of the Royal Academy of Sciences of Paris, in 1722, and remained unrefuted for half a century, when in 1772 it was satisfactorily disproved by Fougeroux de Bondaroy. The supposed male is exceedingly minute, and of a very narrow form. This parasite belongs to the order *Isopoda*, in which it forms a distinct section, named *Epicarides* by Latreille.

BORAGE is the *Borago officinalis* of Linnæus. It belongs to *Pentandria Monogynia*, and to the natural order of which it is the type, viz. *Boragineæ*. Generic character: calyx five-cleft; corolla rotate, limb cut into five lobes, throat with a vaulted margin, on which lanceolate filaments are seated; anthers incumbent, oblong or lanceolate, and posited together; fruit turbinate, plain at the bottom. There are six species of borage, two of them are British annuals, the others are from the Levant. The officinal borage is a common kitchen garden herb, being used for various purposes, as well by the cook and butler as by the apothecary. The juice yields nitre; and on this account, perhaps, its medicinal virtues are considered salutary. It is cultivated by sowing seed on a small bed of fresh digged ground; thinning out the seedlings to six or eight inch distances, and keeping them free from weeds. The young leaves are an ingredient in dressed salads; and the young flowering shoots are thrown into the drink called "cool tankard." The seeds, which are shed in the autumn, rise on the same spot in the following year.

BORAGINEÆ. Borage family. A natural order of dicotyledonous plants, containing about thirty genera, and nearly three hundred species. This order, from the rough leaves of most of its species, sometimes receives the name of *Asperifolia*. It is nearly allied to the *Labiatæ*, from which it is distinguished by having regular flowers, five fertile stamens and a round stem. Its essential characters are: calyx monosepalous, regular, with five divisions, persistent; corolla hypogynous, monopetalous, regular, five-lobed; stamens five, inserted on the corolla; ovary four-celled; ovules pendulous; style simple, terminated by a two-lobed stigma; nuts four, distinct; seeds without albumen.

The plants included in this order are herbs or shrubs with varied stems, flowers in spikes, racemes or panicles, and alternate leaves, which are generally rough. They are found abundantly in the temperate latitudes of the northern hemisphere. Many of the species are natives of Europe, very few are found in arctic regions, and scarcely any within the tropics. In North America they are less abundant than in Europe. The borragineæ are in general mucilaginous and emollient. Sometimes they possess astringent and narcotic qualities. Some of them are weeds which are never cultivated, while others, such as some species of *Echium* and *Symphytum*, are valued on account of their beauty. They are propagated by cuttings, divisions, or seeds. The chief genera of the order are *Borago*, whence the name of the order is derived, *Anchusa*, *Lithospermum*, *Echium*, *Pulmonaria*, *Symphytum*, *Myosotis*, *Cynoglossum*, *Lycopsis*, and *Asperugo*.

Boraginea.

Borago officinalis, common borage, is found pretty abundantly among rubbish and waste ground in Britain, although scarcely considered indigenous. Exhilarating qualities were formerly attributed to this plant, and with the alkanet, roses, and violets, it was reckoned one of the four cordial flowers. It possesses emollient, diuretic, and sudorific qualities. Its leaves are considered in some countries as refrigerant and cordial. A syrup is prepared from them in France, which is used in pleurisy and inflammatory fever. The plant has an odour like cucumber, and communicates a peculiar coolness and flavour to any beverage in which it is steeped. With wine, water, lemon and sugar, it forms an ingredient in the favourite English drink called "cool tankard." It has been employed in cutaneous diseases. Its diuretic qualities are owing to the nitre or saltpetre which enters into its composition.

The roots of the *Anchusa tinctoria*, alkanet or dyer's bugloss, are imported into this country from France and Germany in a dried state, for the purpose of being used in dyeing. The alkanet is a native of Europe, and is frequently cultivated in Britain. Its roots have a bitter taste, and their bark yields a reddish-brown matter resembling resin, which is used for giving a red colour to oils, ointments, plasters and salves. The corks of Port-wine bottles are sometimes stained with it by way of deception. To alcohol it imparts a carmine-red colour, which by evaporation changes to blue, and then to green. This root is also used in compositions for rubbing and giving colour to furniture made of mahogany. Wax dyed with it and applied to the surface of warm marble, tinges it of a flesh-colour, which sinks deep into the stone. The small roots are best for dyeing. *Anchusa sem-*

pervirens, or evergreen alkanet, is found in waste ground and among ruins in many places, both in England and Scotland, and is often cultivated in gardens on account of its beautiful blue flowers.

Lithospermum arvense, Corn growwell, or *bastard Alkanet*, is also a native of Britain. The bark of its root abounds in a red dye, which imparts a fine colour to wax and oils. The country girls in Sweden and the north of Europe, are said to stain their faces with it on days of festivity. The seeds of the *Lithospermum officinale*, from their stony hardness, were formerly supposed to be useful in calculous disorders. The roots of *Anchusa virginica, Lithospermum tinctorum, Onosma echicoides*, and *Echium nitrum*, are used by dyers.

Echium vulgare, common viper's bugloss, is one of the most beautiful of our indigenous plants. Its flowers, which grow in a spike, are at first of a reddish-purple, and afterwards of a brilliant blue colour. *Echium plantagineum* is used in Brazil in the same way as the borage is in Europe.

The leaves of the *Pulmonaria officinalis*, common lungwort, are used as a demulcent in coughs, spitting of blood, or catarrhal affections. *Lymphytum officinale*, common comfrey, grows frequently on the banks of rivers, and in watery places in Britain. The plant abounds in mucilage, and may be conveniently substituted for the althea or marsh mallow. It is used in bowel complaints, hæmoptysis, and pulmonary catarrh. The leaves give an agreeable flavour to cakes and panada. The young stems and leaves, when boiled, are employed as articles of food. The root is emollient, and has a somewhat astringent taste. A decoction of it is used by dyers, to extract the colouring matter of gum-lac. *Myosotis palustris*, great water scorpion-grass, is a very common, but at the same time a very beautiful weed, and is well known to every one under the name of *Forget-me-not*. The plant is considered as an emblem of friendship in almost every part of Europe.

Cynoglossum officinale, common hound's tongue, is found native in Britain. The plant is soft to the touch, has a dull green colour, and emits a disagreeable odour. The root and leaves are said to possess narcotic properties, but they are seldom used in medicine. The leaves are sometimes boiled and applied to painful swellings, in the form of emollient, anodyne cataplasms. The extract of hounds-tongue is made into pills with opium.

BORASSUS (Linnæus). Is one of the most remarkable of the palm tribe, called specifically flabelliformis, from the edges of the leaves being furnished with dangling threads, resembling those instruments of torture called *cat-o'-nine-tails*. Class and order, *Diœcia Hexandria*, and natural order, *Palmæ*. Generic character: a branched spadix issuing from a common spatha; male flowers aggregated; calyx three-cleft; corolla of three petals on footstalks. Female flowers solitary, calyx of three sepals; corolla of from six to nine petals; stamens abortive, and connected below; stigmas three; berry, tripyrate, pyrenes inversely egg-shaped, involved in fibres. This palm is a native of the East Indies, and is a magnificent vegetable; the stem, and regular figure of its fronds are imposing, though not so useful to mankind as some of its congeners, it nevertheless yields both a sugar and a vinous spirit from the pith of the trunk.

BORBONIA (Linnæus). A genus of evergreen ornamental shrubs introduced from the Cape of Good Hope. Class and order, *Monadelphia Decandria*. Natural order, *Leguminosæ*. Generic character: calyx near five-cleft, segments nearly equal and rigid; corolla, exterior hairy, standard marginate, keel obtuse. Pod, often one-seeded, and pointed. This tribe are neat green-house plants, easily preserved and propagated by cuttings.

BOREUS (Latreille). A genus of small but remarkable insects, belonging to the order *Neuroptera*, and family *Panorpidæ*. The prothorax is large; the females are wingless, and the abdomen in that sex is terminated by an exserted conical ovipositor; the males have rudimental wings. The only species is the *Panorpa hyemalis* of Linnæus, figured by Panzer under the name of *Gryllus proboscideus*. It is found throughout the winter, under moss in the north of Europe, as well as on the Alps, where it is observed running about on the snow itself, as we learn from the account given by Dalman in his Analecta Entomologica. This insect is about a quarter of an inch long.

BORKHAUSIA (Böhmer). An extensive family of annual and biennial herbs, mostly natives of Europe. They belong to the natural order *Compositæ*, and bear small yellow flowers.

BORONIA (Smith). An interesting genus of New Holland shrubs, with handsome flowers and foliage. Class and order, *Octandria Monogynia*, and natural order *Rutaceæ*. Generic character: calyx, four-parted or cleft; corolla four long petals, which soon wither; four short stamens standing opposite the petals, those intermediate being abortive; filaments round the germen, incurved, thickened at top, anthers heart-shaped, fixed by the back; style simple, stigma capitate or quadrate; capsule four-lobed, four-berried, each berry two-seeded.

Boronia.

BORYA (Willdenow). A family of North American shrubs belonging to the natural order *Euphorbiaceæ*, of no beauty. The late Sir James Smith altered the name to *Bigelovia*.

BOS (the Ox). A genus of ruminant mammalia which is generally distributed over the globe, in one or other of its species, and altogether, perhaps, the most useful to man in the whole range of animated nature; and for that reason, one the knowledge of which is peculiarly valuable.

Some notice has already been given, under the word BISON, of one of the groups, or subgenera, into which the genus is divided. That group, however, in its two existing species, as there described, has always belonged to wild nature; and though the flesh is esteemed, and the skin is valuable, as is the case with all the ruminantia, and with this genus of them in an especial and pre-eminent manner, the bisons have always been creatures of free nature, the strength of whose necks has not been subjected to the yoke, nor have they been trained, except in a very partial manner, to obey the voice of man as their master. But the two groups which remain to be noticed, and to a brief account of which we shall devote the present article, have been domesticated.

The characters of the genus have their average or typical representation in the common ox, with which every one is familiar. The skull in all the species of this genus is strong in the anterior and upper part, with the front convex, flat, or concave; the horns are circular in their section, but variously formed and of different sizes in the different species. They are produced upon cores of bone, which are always more or less porous, and said in some of the races to communicate with the nostrils, through duplicates of the frontal bones. The true horn consists of a sheath produced upon this core, which receives a new layer on the inside every year. It is naturally smooth, but as the animals advance in size, the markings of the different layers toward the root of the horn give it a slightly annulated appearance. The horn is produced from the epidermis of the forehead, and not from the bony cone; only the last produced layer is attached to the epidermis; and if the horn is accidentally broken off it is not produced. The muzzle is broad and square, or appears truncated, and it is usually of a black colour; but the colour of the tongue and inside of the mouth varies. The ears are of considerable length, and project from the head. The body is rather long, but at the same time stout; the legs are stout; and the hoofs broader in proportion than those of the other two-hoofed ruminantia. Most of the species are gregarious, and some of them naturally congregate in large herds. The males, especially in the more gregarious species, fight desperate battles of gallantry; and in the pairing season, they are very pugnacious. They show their hostile disposition by tearing up the earth with their horns, and scraping and pawing it with their feet; at these times they bellow with a deep and hollow sound; but when the males attempt to low, their voices generally fail, as if they were hoarse. The voices of the females are more shrill; but they are not heard at so great distances as the deep bellowing of the males. When the passions of the males are excited, their eyes have a glaring and fiery lustre; and their passions are apt to be excited by circumstances which do not affect other animals. Blood spilt on the ground excites them very much; and so does any thing which is of a red and glaring colour. The young of all the species may be, to a certain extent, tamed; and some of them will even follow the hunters by whom the mothers have been killed, but the males of none of them can be said to be reduced to a state of great obedience, especially at that season when they are under sexual influence.

Generally speaking, they are inhabitants of the plains, and of plains where vegetation is moderately rich; and as they are heavier in the body, they are less fleet and discursive than the other ruminantia. They subsist chiefly upon green vegetable matter; the grasses, some leguminous plants, and the leaves of various deciduous trees, but they are not so fond of the latter as some of the other genera of the order. Their mode of eating differs from that of all other grazing animals. They do not nibble, but bite rather slowly; and as their upper lip is not prehensile, they use a peculiar licking motion with the tongue to gather in the grass which is divided by the bite. None of the genus are carnivorous; but they gnaw bones and other hard substances, and it is said that in some places the domesticated ones can be made to eat fish. Though there are considerable differences of appearance, habit, and geographical locality, in the various groups and species of which the genus is composed, it is understood that all, or nearly all, may be made to intermix in breeding.

The domesticated ones are remarkably yielding to circumstances, and readily take a very distinctly marked character, from differences of climate, pasture, and treatment. This plastic nature is of great advantage to those by whom they are reared, as it enables them, by crossing the breed of one place with that of another, to improve any particular quality that they may desire,—such as size and strength, if they are intended for labour; superior quantity or quality of milk, if for the dairy; and facility of fattening and flavour of flesh, if intended for food.

With the exception of the single species of bison mentioned in a former article, there is no evidence of any of the genus having at any period inhabited the American continent; and there are no vestiges even of that species in South America. This, however, is not owing to any want of adaptation in the climate, or the spontaneous productions of that country, to the habits of the animals; for those which were introduced by the European colonists have multiplied to an extent unknown in any other part of the world, so much so. indeed, that they are often captured for the skins only, and the flesh left to feed the vultures.

On the eastern continent, the native races in the wild state, have in all probability very much declined, though from the confusion which long prevailed of one group with another, their progressive history is not the most satisfactory. Fossil bones of all the groups are, however, met with; and some of them in deposits which we must suppose to have been formed long before the existence of any historic records of the places where they are found. Besides the bison, as already noticed, the groups are the common ox and the buffalo.

THE OX GROUP. Of all the genus these have been the most celebrated; and they are, in all probability, the first animals which man brought into a state of domestication. They are understood to have been originally natives of the middle latitudes, the plains by those rivers of central Asia, the banks of which are now, in many places, encroached upon by the deserts. This original locality of the group is inferred from its favourite pastures, rather than from any peculiar climatal adaptation; for, in consequence of that obedience to climate to which allusion has been made, the ox can bear a greater range of latitude than most animals; and it thrives as well in those which are rather high, and also in places, such as Australia, where there is not a vestige of any of the genus ever being native, as in the places where the bones are found in fossil state. It would be vain however, to attempt tracing the history of this animal, or attempting to determine the native locality of the race from which civilised nations originally derived that species which is now, and has from time immemorial been, of so much value to them.

Nothing tends more forcibly to prove the early period at which the ox was appropriated by man, and the advantage derived from the appropriation, than the association of that animal with religious rites and astronomical allusions. That the bull was the object of direct worship among the ancient Egyptians, and that it continues to be so to this day among the Hindoos, is well known. It had also large typical honours among the Greeks and Romans; and even with the Jews, under the Mosaic ritual, this animal was the most costly sacrifice. There are traces of very high regard for these animals among all the nations of the eastern continent; and among some of them the names of cow and calf are the terms of fondest endearment which the people apply to each other. This would lead us to suppose that the domestication of the ox was, if not the cause, at least one of the earliest and most efficient means of civilisation; and, if the expression may be allowed, there is a disposition to the society of man in the animals of this group, which is not so apparent in any other. The ox does not, it is true, voluntarily offer his neck to the yoke, and the female of the group does not come spontaneously to be milked; but the gregarious propensities of these animals, which is peculiarly strong, leads them to associate readily with almost any other animals, which have no disposition to offer them direct injury.

They are also much more constant to their localities than the lighter members of the order; and these are the very localities which are most enriching to man as a visitant, and a resident, and a cultivator. We have a remarkable instance of their superiority in this respect, in the contrast of the ranges necessary for cattle and sheep, in those parts of our own country, which cannot be profitably brought under the plough, or which, at all events, have not been so brought. If the country is to be thrown profitably into sheep walks, the cottages must be removed over a very considerable breadth, so that the sheep may have free range; and the sheep nibble the leaves of the shrubby plants as well as the grasses, and have a tendency to reduce the country to that bare and bleak state which suits best with their own healthy condition. A moist climate, and humid and soft soil, are also ill suited for these animals; as the water lodges in their fleeces, and makes them heavy and fatiguing to the animals, which heats them, and as the heat is carried rapidly off by the evaporation from the fleece, their strength is exhausted, and they are subjected to diseases of the lungs. Their feet, too, from the comparative narrowness of the hoofs, sink deep into soft and boggy ground. This also fatigues them; and besides, the moisture acts on the frogs or soft parts of the hoofs, which are altogether of less consistent structure than those of the ox tribe, and they are seized with "foot rot," or mortification of the lower part of the foot. Nor is it the weakly sheep which are subject to these casualties; but rather those which are in the best condition, and on that account the most apt to feel the weight of the rain in their coats, and to sink deep in the soft ground. They are also, altogether of more delicate constitution, and less able to bear severe weather than the ox tribe.

These last do not range so widely in their daily feeding, they are less disturbed by human habitations, or by the presence of other animals on the same pastures. Rains injure them but little in comparison, as their coats throw off the water, so that it does not load and fatigue them as it does the others. Their feet are broader in proportion to the weight of their bodies; their hoofs are of more compact and firm texture, and not liable to be rotted, or otherwise injured, by humid pastures. They are indeed partial to such places, as they prefer the grass when there is some moisture upon it; and accordingly, their chief feeding times are in the morning and the evening, and in the heat of the day they retreat to the shallow waters, and stand in these, chewing the cud with much apparent satisfaction. Sheep, on the other hand, continue to nibble all day long, but they are apt to suffer if they remain on their pastures after the dew of evening is formed.

The ox tribe is much less liable to disease of any kind than sheep are, unless it be diseases which are brought on by a deficiency of food, or food of an improper quality. The true grasses are their most natural and proper food, and they are always in the best condition in places where those grasses are native. This circumstance alone would point out the middle latitudes as their natural geographical habitats. They also readily eat the leguminous plants, and the smaller species which are found on dry pastures, or indeed any of the species when dry, are not unwholesome for them; but when the rich clovers, in a state of vigorous growth, and when wet with rain or dew, are taken into the stomach, they ferment and give out so much gas, that the paunch is in danger of bursting, which is of course fatal to the animal. Even this, however, does not appear to affect the system with disease, and thus it is no argument against the general healthiness; for an incision made into the distended paunch, if so made as not to injure the other viscera, suffers the gas to escape, and all is well.

Thus the ox points out to man those places where it is most advantageous to settle and begin the labour of cultivation, which may be considered as the primary foundation of all improvement. It was probably, indeed most likely, for this reason, that the bull found so honourable a place in the mythologies of all the civilised nations of antiquity, and in the sacrifices under the ceremonial law of the Jews, and for the same reason that he found a place, and the peculiar place which he holds, in the signs of the Zodiac.

We have seen a fanciful parallel drawn between those signs, and the progress of man in civilisation, which though probably not literally true, is yet worthy of being repeated. The Ram (*aries*) was typical of the primary or pastoral state, under which only single families, or small septs of people, could live in communion with each other; and there could not only be no communion of opinion, or unity of purpose among people in such a state, but they must have been at continual war with each other about the invading and the defending of their pastures. So far as we can glean from what is recorded in Holy Writ of the patriarchal ages, when there seem to have been as many kings as hamlets in Syria, this appears then to have been the condition of that portion of the world. The Bull (*taurus*) was emblematical of settlement and culture; and this appears then to have been the condition of Egypt, and the richer parts of the world; and we find that down to a considerably advanced period of their history, the Jews, whenever they fell into idolatry, usually had recourse to the symbolic calf as the idol. The Twins (*gemini*) were expressive not only of the fertility and consequent abundance which followed the domestication of the ox and the practice of agriculture, but of the brotherhood, or the union of man with man for purposes of mutual advantage, which was the immediate consequence. The subsequent part is considerably more fanciful, as when men are once civilised, the objects of their pursuit become so numerous, that no one subject can be emblematical of the whole. The Crab (*cancer*) is considered as indicating the firmness of that brotherhood, the establishment of which is typified by Gemini. The Lion (*leo*) the strength of men when so united. The Virgin (*virgo*), the elevation of woman in the scale of society, which has always been in proportion to the degree of civilisation. The Balance (*libra*), the institution of commerce, after considerable bodies of men had found it their interest to live at peace with each other. The Scorpion (*scorpio*), the ambition for discovery and for conquest, which has marked a certain stage of the history of all civilised nations and races. The Archer (*sagittarius*), the wars to which this ambition led. The Goat (*capricornus*), the passage of the mountains (which the goats inhabit) and the consequent extension of knowledge or conquest beyond the original valley. The Water-carrier (*aquarius*), the passage of the confining river or strait; and the Fishes (*pisces*), the launching of the ship upon the open sea, and the subsequent progress of discovery till man circumnavigated the globe, laying the foundation for universal intercourse, and for the enjoyments of the whole products of the earth by the whole of the earth's inhabitants.

The fable here may be fanciful, but the application is correct, and the whole affords a very good instance of allegoric reasoning. It will be seen that the bull or ox in the fable, is the point from which union, and the strength and effects of union among men, are dated; and the same is true in the real history of human improvement.

We do not say that the ox has been the sole cause of the localising, and consequent civilisation of man, because the first steps of civilisation, in any other way than from the example of those already civilised, are not upon the historic record. Nor can we expect that they should, for the existence of a record is itself an indication of rather an advanced state of society. Of the certainty of the matter,—of the first impulse to all those comforts and enjoyments which we possess over the wild men of the woods,—we must therefore remain in ignorance; but the subject is one upon which it is both pleasant and profitable to conjecture, inasmuch as our very guesses as to how civilisation, and civility between man and man were begun, not only put us in the way of spreading their progress, but reprove us sharply if we fail in the performance.

Now we can find in the natural habitats of the ox, more incentives to activity of mind, and variety and versatility of thought, than in the wood of the hunter, or by the shore of the fisher, and as these are still the best means of promoting improvement, we may naturally suppose that they were the most likely means of its commencement.

Where nature shows no change, man remains in the same state. The Bedouin of the African desert, and the native of Australia, have remained in the same condition time out of mind; and in all places where people have continued for ages without any improvement, we may naturally suppose that they remain so, not in consequence of any effect of climate or other physical action upon the body, but from want of stimulus to the mind; for we have the evidence of history in all climates, from Iceland to the Equator, that if this stimulus is supplied, man may be equally energetic under any parallel; and that, if the intellectual part can be sufficiently roused, it will soon teach the body to triumph over physical circumstances, unless in those extremes of cold or of drought, in which there is nothing upon which ingenuity can act. Nay, even there, it is the absolute extreme only which is desperate; for in the centre of the Indian desert, we find an inhabitant who cultivates his water melons, and digs hundreds of feet into the earth for water; and on the northern shore of America, in the region of winter, where no metal can be touched without affecting the hand in the same manner as fire does, we find the Esquimaux dwelling in the snow, and finding his food upon the ice. Still there must be a stimulus, and it is doubtful whether, in the first instance, the stimulus of necessity is sufficient, because, though an urgent one it carries a blight, a withering of all hope along with it.

The natural climates of the ox tribe, are those in which there is the most rapid and the most agreeable variety of seasonal action,—there is the most to be observed, and man is able to be at all times and seasons, most observant of it. There are various reasons why man, when he lives in the thick forest, or in the fastnesses of the craggy mountain, should remain unchanged. The vegetable world is the best calculated to rouse his attention, as the changing vegetable remains in its place, and allows him to command and examine it in all its states, while with most animals, it is but a sight and away. But the vegetation of such places changes little during the lifetime of man; and as the mountain, the rock, and the waters, which change not for centuries without some convulsion of nature, which must drive man from that locality, are the most conspicuous objects, they have still a greater tendency to chain down the mind to permanent routine. The oak in the forest stands for centuries, and there are many species of longer duration. In the extremes of latitude, where the *two* seasons are the most marked, either by heat and cold, or by humidity and drought; and where spring with its blossoms and autumn with its frosts, do not mark half the year with the energy and the fruits of nature's action, there seems little in the appearances of nature around which can stimulate man to be up and doing. The pine forests of the north are, if the expression may be allowed, "dismally everlasting;" and they tend to choke all other vegetation, the appearance of which is calculated to give interest.

Those who have what is called "a painter's eye," that is, who have a feeling of the beauty of scenes, complain of the dull and gloomy monotony of pines, in all situations where they are not relieved by other trees. But the feeling which is capable of deriving either pleasure or pain from scenes, always goes deeper than mere external appearances; and, though the party may not be aware of it, there is always something mental,—some feeling of relation in addition to the affection of the sense. It is on this account, that the trees in question are not pleasant;

the connections which they suggest to the mind, are those of dulness and death.

The perennial green of the tropical forest, has much the same influence upon the mind. No doubt it has its alternations of wet and dry, just as the polar one has of heat and cold; but it has these only, without the spring and autumn, and their succession is so rapid and so violent, that man can hardly take notice of the changes, and cannot at all profit by their appearance. The perennial leaf, too, makes the feeling of the same dull character as in the opposite extreme; and, as in the other case, man has no hope but just to leave the world at his death in the very same state in which it appeared to him at the first opening (for, in such places we must not say *use*,) of his eyes.

To those who look only for the common descriptions of animals as they appear to the eye, and as they might be better understood by one glance at the living animal, or even at a figure of it, than from the most elaborate piece of writing that could be put in words, these remarks may appear lengthy and out of place, in an article having the name of a single genus of animal for its title. But such remarks have been so much neglected by even the best writers on natural history, that they have no names in the vocabulary of the sciences—no titles under which they can be separately treated in an alphabetical arrangement, and they are at the same time so much more important than even those other subjects which have names in every book, that we feel not only justified in introducing them, but bound to introduce them, upon every favourable occasion. To know the details of one subject, as fully and accurately as possible, is very proper and very necessary as far as it goes; but it is a very small matter compared to that of being able to know the part, and the view of nature which shall be to us both book and instructor, which will not only take all the heaviness of taskwork out of our attempts to learn, but make the grand function of the mind—the acquiring of knowledge, go on in the same way as the grand functions of the body; that is, not only without interruption to any of the others, but furthering every other in proportion as it is in itself vigorous.

This seems an obvious, as well as an admirable view of the acquiring of knowledge; and one can hardly imagine how it can have escaped all those who have hitherto written on the subject. In the common business of life, the body has a part to perform, and so has the mind. The relations of them to each other vary with the occupation—as the body more in him who works as he is directed, and the mind more in him who directs the working of others. Farther, the exercise in this way is, up to a certain degree, healthy both to the body and to the mind.

Now, we all know that the business of life, whatever it may be, goes on the more energetically and successfully the more healthy that the body is—that is, the more freely and completely that all its natural functions, such as digestion, or the circulation of the blood, are performed. Now, with the knowledge of the universality of this fact, it seems passing strange that there should be, not only a prejudice against the analogy, but a direct denial and denouncement (sometimes not a very temperate denouncement) of it in the case of mind! The healthful function of the mind—the process of thinking, knowing, planning, and inventing, can no more fatigue the mind, or divert it from the performance of its part in life, than the healthy exercise of the bodily functions can so fatigue or divert the body. Indeed, it cannot so much, or even at all; for, though we are in the habit of speaking of mental fatigue, or distraction, just as we are in the habit of speaking of mental disease or derangement, yet the mind is equally incapable of the one and the other. Sleeping or waking, the mind is always thinking; only the idle thought perishes, effectless and useless, like the obscure dream of the sound sleeper, which, because it touches not the sense, leaves no trace on the waking mind—or rather on the mind after the body has awakened. See Dream and Sleep.

This view of the subject is of the greatest importance, and the neglect, or rather denial and resistance of it, cuts mankind off from more of the usefulness and pleasure of life than all other causes put together. The man who thinks the most, is capable of acting the best and the most also; and so conversely, he who is the most active in his body, is also the best capacitated for being active in his mind. It is sometimes said that men injure their bodily health by study; but it is quite a mistake, unless what is vulgarly called "brown study" be meant—that in which the mind stands still, and holds the body in inaction along with it.

Thus, whether we speak of the interruption given to business by thought, and the acquiring of (a habit of) knowledge in those who are not professedly students, or the injury done to health by the sedentary habit of those who are, we are equally in error, and thus express ourselves either on account of our ignorance of what knowledge is, of the nature of the human structure as a compound of body and mind, or of both. The healthful state of the whole man, that in which it can best perform that which it has to perform, whatever that may be, is the state in which those functions of the body and of the mind, which may singly be called the life of each, and together, the life of the whole man, are all performed with equal energy. If the one is really active, it will not allow the other to be idle; and when a man of action becomes studious to the neglect of his business, or a man of study to the injury of his health, we may be sure that it is mental dissipation or indolence, and not mental labour, which is the real cause of the mischief; and as there can be no indolence of weakness or of fatigue in the mind, as there may be in the body, we may be sure that another step of the analysis would bring us to the want of stimulus—to a perverted doting and dreaming upon that in which there is not sufficient excitement.

This would bring us back to the natural pastures of the ox tribe, as the places of the earth most eminently fitted for stimulating the human race to civilisation at the first, and to the animals themselves; as, from the readiness with which they can be domesticated, and their varied uses when this is accomplished, one of the principal means of forwarding that civilisation which their pastures are so well calculated for beginning. But there is still one general point, upon which we shall venture to make a remark or two, before we go on to any thing partaking so much of detail as even the account of this numerous and important genus of animals; and we do this the more readily, that what we have to say has, besides its importance in the general subject of knowledge, and the means of acquiring it, a very strict bearing upon natural history.

It is not the simple appearance of objects to the senses, as portions of mere matter, and without change either of place or of state, which is calculated to stimulate the mind to thought, and the body to action. Thus, when we look at the portraits of animals, however faithfully painted, or at their skins in a museum, however well preserved and accurately set up, if there were no more in them than the eye sees, they would give us no more pleasure, and please us no longer, than so many spots of colour daubed on a wall. If we could not, in some way, connect the specimens which it contains with life and living action, the sight offered by the finest museum in the world would not afford a fairer sight than the window of a draper's shop to one of a nation that do not wear clothes. A very striking, and by no means an uninstructive instance of this, occurred in London some time ago, in the case of two red men of the woods—two young chiefs of a very partially civilised tribe of North American Indians. They had come so far to see the world, and they spoke the English language, and conformed in great part with the costume and the manners of the country, so that they were very far above the first step in civilisation; but as those who took upon themselves the office of conducting them through the streets, were pointing out to them all the finery and wealth which are there displayed, they turned away with perfect indifference from all the grandeur and the riches, and expressed their wonder that *men* should waste their time, and occupy their attention, with such trifles. But when they passed the window of an eating-house they were in raptures, and burst out into loud encomiums on a country where a man "could eat whenever he was so minded."

The conduct of these Indians was true to the state of their knowledge, that is, to the relations of usefulness which were suggested by the objects which they saw. They were not aware how many of the people of this country depended upon those articles which they despised for a share of that food which they beheld with so much admiration. But those Indians were human beings, true to the common feeling of human nature; and there is a very valuable lesson to be derived from their case—namely, that it is to no purpose that we show the object, be it what it may, if we do not explain the use, or make sure that the person to whom we address ourselves is acquainted with it. In natural history the lesson is peculiarly apposite; for if we merely show the animal, the plant, or the other object, be it what it may, and remain silent as to the action and the use, those whom we attempt to teach will turn away from us with the same indifference as the Indian chiefs, and direct themselves to something which is palpable to the senses, as contributing to some purpose.

And if man is naturally placed where the objects around him, whether on the earth, in the waters, or in the atmosphere, show no change, they hold out to him no incentive for thought, and there is nothing to rouse him from ignorance. If nature is to be an instructor, there must be natural actions seen in the beginning, the middle, and the end, and the shorter the time in which this takes place, the lesson which it affords is the more valuable. On this principle (and it is a universal one) we may conclude, that if man had not seen the plant of the temperate climate, or the middle latitude, spring up and reach its maturity in the course of a season, or of so brief a period of time that he could carry the whole of the facts along with him, he would never have become a cultivator; but it is in the native pastures of the ox division of the genus bos that this is to be procured in the highest perfection, and therefore it is in these that, as we may safely conclude, civilisation had its beginning.

But the ox not only thus leads man to the regions where he has the proper stimuli to cultivate, but it, more readily than any other animal, assists him in the cultivation. The bison may be, in some sort, an exception; but that stage of a country which is the best adapted for cultivation is one from which the bison retires; yet even the bison, especially in the American species (see the article Bison), shows no dislike to the society, or at all events to the neighbourhood, of man. The young bison will follow the hunter who has deprived it of its parents, which is perhaps the strongest attachment to animal society, without reference to its own species and kind, which we find in any wild animals.

There is another property of the genus bos, and especially of this division of it (of which the domestic ox may be regarded as the type), which must have rendered it peculiarly advantageous to the human race in their early migrations, and of which we have very remarkable proofs in those cases of extensive colonisation of distant parts of the world by European settlers which have taken place in more modern times:—Of all animals, the ox is, next to man, the most plastic to climate, and hence domestic oxen are divided into more varieties or breeds than any other animals. If removed into countries analogous to those which many may suppose were inhabited by the bison, and in which the remnant of that division of the genus is still to be found, and exposed to the severity of the weather, the ox acquires a shaggy and bison-like character; and if, on the other hand, it is removed into climates resembling those in which the buffalo is found native, it takes more of the appearance of that animal.

There is not, perhaps, change enough produced in either case for enabling us to say that all the divisions into which this most interesting genus is broken have resulted from climate, but there is as much as renders our separation of the genus into species doubtful and unsatisfactory; for though we find what we may consider as specific distinctions in the external appearance of the form of the frontal bone and the number of the ribs, yet there are physiological coincidences in all the species, so far as has been observed, which are of equal, if not greater, importance than these. The different species have bred together in many instances, and they probably would do so in all; but there are no mules among those hybrids which are barren to each other, though they breed back to the pure blood of either parent, as there are, without exception, in the hybrids between the horse and the ass. [See the article Ass.] Now, if there be any meaning (that is, any physiological meaning) in the word "species," surely that which can continue itself, without the calling in of any other race, and can do this from any one pair, is unquestionably the best foundation upon which a species can be built. In describing, and knowing by description, the external characters, or rather appearances, of these animals, the names of the divisions of species may be admitted, but we cannot be too careful lest we thereby break down the physiological unity.

This double classification, or rather the taking care not to be led away by it, is a very important matter in the useful *study* of natural history, not only as it prevents those views about the origin of animals, into which they who examine no farther than the external differences are in constant danger of falling, but as it is of real and practical use to those who use the animals for domestic purposes. Every well-informed grazier knows that he may obtain any shade of character that he pleases between the widest extremes that are to be found in the domestic varieties; and thus he can breed for the table, the dairy, or the draught, with equal facility. So can he also breed for the pasture, both as to climate and to kind of food. Thus, in whatever part of the country there is food and necessity for one of those animals, that animal can always be the one most profitable in that particular locality, and this extended over the whole country renders grass and grazing profitable to the very maximum in a national point of view. All this may be done with a very moderate degree of knowledge, if that knowledge is of the right kind. The breeds must be known in their qualities and in their effects upon each other in crossing, both of which are matters of simple observation; and if there be added a knowledge of the local causes, the climate, the food, and the treatment, and the extent to which they influence the character of the breed, then the grazier has only to act according to his knowledge to obtain the most certain and profitable result. But the foundation of the whole is the fertility of the produce of these crossings.

It is worthy of remark, that this general fertility, and the advantages which result from it, are conspicuous in proportion as the animals possess the other qualities which facilitate their domestication, and also those which render them useful in the domestic state. It is in this, and not in what has been called the sagacity, and sometimes "an inferior kind of reason," that the nearest approach to man on the part of the other animals consists. When we take up the hypothesis of the "inferior reason," we at once get upon dangerous ground, and are mired if we venture a step. But here we are not only quite safe, but upon an elevated rock, which commands a wide view of the beauty and utility of nature—such a view as is of itself sufficient to convince us how bountifully we have been treated, and by whom. The sagacity of the dog has not only been selected as the nearest approximation to thought in man, but the dog has sometimes been called the means of civilisation, or, at all events, the stimulus to it, while the ox has been put aside with the brand of stupidity, and the sheep with that of silliness. Yet it is this very stupidity and silliness, or rather that which has been so called, not very wisely, which forms the value of these foremost of all animals in an economical point of view. The natives of New Holland, when first discovered by Europeans, had dogs, but they had neither clothing nor habitations. They cultivated no plant, and their traditional history did not go back to the whole lives of their immediate fathers, nor did their knowledge of geography extend beyond the hill or the flood which bounded their immediate horizon. As they were savage men, their companion was a savage dog; but still they had it, and it was the only wholly placental animal, except some very small ones, to be found in their country.

Man is, as we have had repeated occasion to remark, of all living creatures, the best fitted for enduring varieties of climate, in respect both of heat and cold, and of drought and moisture. This is more an animal than a mental adaptation in man, and therefore it is one in which the analogy of the other animals, so far as they agree or disagree with man, may be admitted without the least impropriety. The approximation toward this may be taken as the leading ground of the fitness of animals for domestication, as it enables man to take them along with him in all his migrations. And no one can refrain from noticing how perfectly the number and value of the uses of animals to man, and also their obedience to his culture, in fitting the breed to the place and the purpose, accord with this pliancy to climate. The ox stands foremost in pliancy both to nature and to art; so does he in utility. Alive, he gives his strength for labour; and dead, his body for food: and, as civilisation advances, there is no part of that body which may not be turned to some useful purpose. No doubt he is, as a labouring animal, better adapted to the more early, than to the more advanced, stages of civilisation; and in Britain, and some other places, the race is bred almost exclusively for the dairy or the table. But, if we take the working world, in all its breadth, we shall find that there is, even at the present time, more of its agriculture and its carrying labour performed by the genus *bos* than by the horse. The ox is slower-footed, but he is more enduring, more easily fed, and, from the structure of his feet, capable of travelling along paths for which the horse is not at all adapted as a beast of burden. In all the hot countries, where, from the violence with which the rains set in, and, generally speaking, from the poverty of the people, roads cannot be made and kept up in the same style as they are with us, the genus *bos*, under some name or other, is the animal for the plough, the team, and the load; nor are there wanting some places where the same animal is used for the saddle.

Thus, in whatsoever point of view we consider this genus, we find it interesting in the highest degree—so much so, that its history and the history of civilisation are so blended together, that we cannot study the one properly, without studying the other along with it. The same causes tend, however, to that difficulty of separating the species in a satisfactory manner, which has been noticed; and thus render the details of the history as unsatisfactory as the general view of it is interesting. We treated of the true bisons in a separate article; however, it does not appear that they have had much (if any) influence in civilisation. Their history in the eastern hemisphere is too distant and dark for leading to any thing satisfactory; and though the American bisons were exceedingly numerous on the first discovery of that animal, and are still so in some parts of that country, it does not appear that they ever led the natives to settlement and culture, or were received by them in any other light than that of prey for the hunter. There are more species of the eastern continent, principally, if not exclusively, of the central and southern parts of Asia, in the eastern division of that quarter, which are frequently classed with the bisons, from some of their external characters (chiefly); but these have not the locality or the appearance of the true bisons; and most, if not all of them, have been in part at least, domesticated. These we shall, in the very short notices which we are about to give, include in the same section with the domestic ox, but without asserting that such an arrangement is right, or admitting that it is wrong;—for as we have endeavoured to show, there is not much science in the subdivision of the genus.

THE COMMON OX, WILD BULL, or URUS (*Bos taurus*, *Bos urus*, of authors). Whether the native stock of the domestic varieties still exists, or whether (as is more likely) these have accompanied civilisation from the East, is a point which cannot be ascertained with any degree of satisfaction, as they contain enough of resemblance, and also of difference, to make the conclusion plausible either way. This species belongs to the living world, only as a very doubtful, and certainly a contaminated remnant, as in the countries where it is said to be found, the domestic breeds were introduced before they were fenced in by enclosures, or any attention paid to the difference of breeds and their characters. We trust however to be able, in the course of our observations, to show that the only variety of *Urus* of which there are specimens existing in an apparently wild state, is in truth nothing more than a small portion of a living and well-known domestic variety, which has been allowed to run wild under peculiar circumstances. Cuvier, with his usual sagacity, says nothing about this original race, in the *Regne Animal*; but as we have the popular writers against us, *totum armentum*, we must proceed cautiously, and guard our steps.

The characters usually given of this species are; the forehead, or front, square and flat, or even a little hollowed in the centre, instead of being arched, as in the bisons; the occiput also flattened, and the union of these two parts forming a ridge at the top of the front; the horns, originating from the lateral angles of this ridge, are round in their section, and they curve outwards, upwards, and forwards; the ridge at the upper part of the front (in the male), thickly set with curly hair, but without any very distinct mane along the ridge of the neck, or beard on the chin and throat; no bump over the interscapular part of the spine, but a dewlap pendent between the fore legs, which becomes enlarged and of firmer texture in the autumn, when the animals are left exposed to the weather; only thirteen pairs of ribs; the tail rather long, furnished with a brush at the point, and the basal part for some length seated in a groove; female with four inguinal teats, arranged in a square upon the udder, which is more enlarged than in most of the other species. The period of gestation (in the domestic species) is nine months; and the female arrives at fertility in a year and a half, and the male in two years. These are also the characters of the domesticated race, in so far as animals which are so much broken into varieties can have general characters.

Of the wild ones there are, or rather there are said to have been, two varieties, if not three. One of larger dimensions is found only in a fossil state, though if we can credit the accounts of the ancients, it appears to have been in existence about the time when the people of the then civilised world began to invade the forests of central Europe. It appears from the localities in which its remains are found, to have been the immediate neighbour of the bison, and it is possible that the one may have been confounded with the other.

There are black *uri* with white chins, and without the shaggy appendages of the bisons, mentioned at a later period of European history; and these are said to have been smaller than the fossil *uri*, and with the horns differently formed. But no very great stress can be laid upon such accounts. The antiquities of natural history are the most vague of all antiquities, though the whole is sufficiently tinged with that character. Somewhere not very far from the place where the remaining bisons are still said to be found, is the locality assigned for these black wild cattle. But we ought to bear in mind, how man had chased man, and civilisation dawned and set in these places, or their near vicinity, between the time when the Romans first established themselves on the Danube, and that at which these wild cattle are said to have been seen. Further, we should bear in mind, that many (indeed most) of the adventurers by whom these creatures were invaded, were from the East, where they had lived wandering or nomadic lives, and subsisted in great part upon these cattle. From these circumstances, it is at least as likely that these had been the descendants of herds now domesticated, as that they were a native race in these localities. Even now, if by any combination of circumstances, the histories of the colonisations of South America and Australia could be as completely lost, as many centuries of that of much of Europe is, future naturalists would be very apt to describe cattle as natives of these countries, and especially of South America, where the unhunted ones have become so numerous, as to reach, or even exceed in abundance, the native bisons of the north of the same continent.

The species of which there are the most recent alleged accounts as being in the wild state, is the *white Urus*, or wild bull (*Urus Scoticus*); and even its history is abundantly vague. Report says that, at one period of British history, and that not a very remote one, these animals ranged at large in the natural forests of the north of England and the south of Scotland, though less is said of their appearance in the opposite end, or even in the centre of either country, where both climate and pasturage were at least as favourable for them. That there have been a few of them at scattered points since people began to observe, or at any rate to record their observations on natural history, cannot be doubted. But these remains of a supposed ancient race are found only in the parks of a few of the great proprietors, which are generally artificially formed and planted; and none are said to have been observed even in the wildest woods, which, in a state of nature, even where these consist of deciduous copse-wood, and abound in grass of the most kindly description, forming the least "inviting" for the proprietary cattle, which are most nearly in a state of nature. Now that any part of the genus *bos*, which in all its species, and in all other parts of the world, keeps aloof from the haunts of man, and fades before the progress of civilisation, if not domesticated and thus made part of the system, should be so wholly changed in one small locality, or rather in a few detached spots of that locality, as to have got into inclosed plantations, and to remain and breed there, and there only, while it has, from time immemorial, vanished from places more in accordance with the usual habits of the genus, is such an anomaly that it cannot be received upon the testimony of any tradition.

We do not, however, question the fact of its having been lately, or being still at the places in question; but the doubtful point, and one to establish the affirmative of which there is no satisfactory evidence, is that it is native in those places. Analogy is against such a position: it is well known that deer in a native state were, up to a comparatively recent period, numerous in many of the wild woods of the island; that they are now thinned; that the artificial parks which contain deer, and even the hill forests, such as that of the Duke of Atholl, between Blair and Badenoch, have been stocked by artificial means; and that the remains of the red deer have taken up their final abode in the very wildest part of the island, the north-western part of Invernesshire, where, from rough mountain and interspersed marsh, the surface is peculiarly uninteresting to human travellers. These are as much natural fastnesses, though of a different character, as those in which the remainder of the bisons have taken up their final abode in central Europe. It is, therefore, unreasonable to conclude from analogy that, if there had been any actual remains of a wild breed of cattle in Britain, they would have been found in the wild plains, and not as ornamental stock in the parks of the great. There must therefore be "some mistake," about the white cattle, and the sooner that it can be removed the better.

That the colour of these animals is nearly entire (it is not wholly so, as they all have the muzzle and the tips of the horns black, and those at Burton Constable have the tips of the ears and tail black also,) is not a proof that they are an original race, which has never been broken into varieties by domestication; for when domesticated cattle, with broken colours, continue for some generations exposed to the weather all the year round, they return to an entire colour, varying in a number of shades from black to dun; and hence the cattle which are bred in the Scotch highlands, have the colour generally unbroken, and black is so much the prevailing shade, that they are known to dealers by the general name of "black cattle."

Before, therefore, we can rationally conclude that the white cattle are a native race that has never been domesticated, and not a domesticated race which has run wild, we must examine what there has been in the progressive history of the places in which they are found, that may bear on the one conclusion or the other. For as this genus of animals has had a powerful influence upon the progress of human society; and as all natural action is in so far reciprocal and mutual, we may very naturally suppose that the state of human society, and the change which that has produced upon the country, must have had a considerable influence upon the character of the animals.

Now both England and Scotland, for some distance from the border, have been for a long period previous to the union, in a very different state from the more remote parts of the countries, and even from a portion upon the confines. The two nations were very often at open war with each other, and they were never cordial friends; and the inhabitants of the border, who consisted of a considerable number of expelled men from each country, were the friends of neither, and the pretended partisans of the one or the other, according as they found it more suited to their own predatory habits. Their "forays," or inroads, were carried on chiefly for the purposes of plunder; and as the portion of Scotland near the border was a poor country, and the court, and army such as it was, were too near for rendering frequent forays into the Lothians safe, unless for larger bodies of men than the border robbers could muster, for people of that description never can combine to any great extent, the depredations were most generally carried on in England; and in that country there necessarily was a considerable space within the border, where men cultivating the arts of peace could not dwell in safety. The better part of this would naturally get overrun with wood or with coppice; and the same would also be the case with a part of Scotland, though to a less extent. Cattle formed the principal booty in these predatory incursions; these cattle had to be driven through the pathless and uninhabited parts of the country; and as the marauders had often to make hasty retreats, and not unfrequently abandon their plunder and defend themselves, it is natural to suppose that the cattle might not unfrequently escape into the wilds; and many of them might remain and breed there till they returned to the entire colour from constant exposure to the weather. This seems the most rational mode of accounting for the existence of the wild cattle in these localities; at least this hypothesis would require to be encountered by very forcible argument before that of an aboriginal breed, in favour of which there is neither proof nor probability, could claim that implicit credence which it has pretty generally received from those who have written on the subject.

We may farther remark that the usual accounts of these animals do not assert that they are aboriginal in the artificial parks; but that they were obtained much in the same way, as no inconsiderable portions of the estates of those who became their owners, that is, they were gotten from the religious houses when those were broken up at the Reformation. This part of the history, if authentic, and there is much more probability on its side than against it, is decisive of the whole case of those white oxen; and not only so, for it renders the whole hypothesis of the *species* (and it is only a hypothesis, not only doubtful, but evidently fabulous). The monks and others, connected with the religious establishments, brought fruits and flowers from Italy for the ornamenting of their gardens; and it is natural to suppose, nay it is impossible not to suppose, that they brought cattle from the same country to stock their parks and dairies; and that such has been the fact, and the origin of those cattle, is placed beyond all doubt, by the cattle of the finer parts of Italy, especially those of the valley of Arno, being white from the time of the ancient Romans, and remaining so at the present time. They are an excellent breed, and highly prized in the West India islands, to which numbers of them were once sent, if there are not so still. It is probable that all those breeds of cattle which have much white in them have been obtained by crosses with those Italian cattle obtained in the manner above stated; and this is rendered more probable by their being more delicate than those of a darker tint. This origin of the white cattle, does not in the least invalidate the ground of their being sometimes found in the woods, or even remaining there as strays from the marauders; for the religious houses were always favourite objects of attack.

The annexed figure, which represents an adult male, after he has attained that age at which the hair on the ridge of the neck becomes prominent and shaggy, will give some notion of the form and bearing of these animals.

Wild Bull.

These animals are of much smaller size than what may be considered their parent stock in the plains of Tuscany; but this, as well as their greater energy of character, can be very readily accounted for from their being exposed to the air all the year round in a severer climate. Breeding "in and in" in an upland district where the woods were thin and the pasture bare would, in no very long time, reduce the largest breed of cattle to the average stature of the natives, if they could be kept alive and in health till the change were brought about; and it is well known that with equal feeding, small and exposed cattle are the most active and pugnacious.

If the remarks which we have made on this supposed original variety of the domestic ox are true, and we trust we have carried along with us the reader's conviction that they are, the peculiar manners of the white cattle in those parts of Britain where they are found become of no more value there but as they show the change which one variety of the species which has been long domesticated in a climate remarkable for its mildness undergoes, when it is allowed to run wild in one which is less favourable; and really, all that we can discover is so like what takes place with cattle of any other colour, black, brindled, brown, or dun, that it is not worth mentioning. The animal gets smaller, more shaggy in the hair, and a little wilder in disposition; there the whole matter ends; and as the same thing happens not to all the varieties of the common ox, but to the genus and (in a greater or less degree, according to their susceptibilities to climate,) to all animals, it teaches nothing.

This however is not all, for the existence of any such animal as the *urus*, whether white or black, within the period of authenticated history—that is, as *a living animal* within that period—becomes exceedingly problematical; because, as we have already shown, the black *urus*, which is described as having been seen (or heard of) in south-western Russia some time by gone, if it had any real existence there at all, is much more likely to have been a remnant of domestic nature turned over to the wild state in the course of human revolutions, than a fragment of wild nature which had survived there. As for the urus of earlier wastes, again, if we are to suppose it any thing else than the ox become shaggy and violent in an inhospitable climate, the most probable conjecture is that it had been the bison—the *aurach, uarach*—the rough or shaggy animal.

Thus in our attempts to trace the genealogy of the domestic ox, even in those varieties with which we are most familiar, to any wild animal in a state of wild nature, we are forced from the living world to the grand charnel-house, the earth; for we might as well attempt to trace the human inhabitants of any particular part of the world, up to the present time, without the assistance of any historic record, as to trace to wild nature, an animal of which we know nothing save in a state of domestication. In such an inquiry, even unlettered man can give us no clue to his history. Ask the native of Australia whence came his ancestors, and how men who now know, of their own invention, no other means of navigating the waters than astride a log of timber, how their fathers contrived to stem the dangerous tide of Torres' Strait, to say nothing of the Indian Ocean or the Pacific, and you will find that his knowledge of the matter does not reach the time of his grandfather. Neither will the external appearance, the manners, nor even the language of those very rude tribes help us out; for where thought and knowledge are limited to that which is personally observed, there are as many languages as there are families. Now, if this be the case with man before the dawn of science—who is, notwithstanding, still man, and shows no lack of capacity where he is placed under favourable circumstances, we cannot presume that it will be better in the case of animals, which cannot, under any circumstances, be so educated, even to the smallest extent, and of which the one generation cannot leave a single iota of instruction to that which is to come after.

As to the bones again, they are even more silent in all manner of instruction; and how the races which were lost before the record of history began, may have differed in habit from those which they resemble in skeleton, or how the earth which is now their pasture, may have differed from what it has been at any known time, we are, and we must remain, completely in the dark. Therefore, though the history of the domestic ox is, of all animal histories, the one most desirable to be known, it is one of the most difficult upon which to obtain any satisfactory information. But it is fortunate that the difficulties with which the progressive history is thus beset, do not in the least stand in the way of our reaping the full economical benefit of the animal. Indeed it is the early domestication of the ox, and that plasticity to climate and culture, that render him so valuable to man, which are the chief, if not the sole cause of the difficulty. We shall now notice some of the most remarkable of the Asiatic species or varieties; but to enumerate all, or even a slight approximation to all, would be a very long, and not a very profitable task.

The general shape of the Brahminy bull, which is the sacred bull in most parts of India, and especially in the valley of the Ganges, may be understood from the figure. In Benares, and those other cities which are crowded with the more wealthy and devout Hindoos of high caste, these animals are exceedingly numerous, thronging the streets, and the courts, and areas of the temples. They are fed to the utmost profusion, and they are very fat, indolent, and inoffensive. When left without these attentions they are smaller and much more active, but they have been so long domesticated, or rather under the protection of the people, that there are many varieties

Indian Bull.

in appearance. When they are fat, the hump on the shoulders and the dewlap are very much produced, and in all conditions they have the skin of the neck furrowed with transverse wrinkles. Their general colour is dun, passing into blackish on the upper part, and whitish on the under. There are many varieties of these hunch-backed ones in India, but it is not easy to say which is the original race, or whether those which are found wild be in a state of nature, or have been left in the changes of society which the country has undergone. These humped oxen have the voice less deep than the others, and the form of the hind quarters and the insertion of the tail are different from the European varieties.

The Gayal (*Bos gavæus*) has sometimes been considered as a bison; but it has few or none of the characters of the true bisons. These are light and agile animals for their size, and have great part of their power thrown into the neck. The gayal, on the other hand, is a heavy and clumsy animal; and the neck, especially the part of it next the head, is small an feeble. The only character which it has in common with the bisons, other than those which belong to the whole genus *bos*, is that of fourteen pairs of ribs; and, although our domestic oxen, and the varieties of other countries which most resemble them, have only thirteen pairs, yet fourteen is not a constant, and therefore cannot be regarded as properly a typical character of the bisons. The Eastern one has fourteen, but the American has fifteen.

The full grown male of the gayal is nine feet and a half long, and exactly half as much in height. The body is rounded and rather clumsy in appearance; and both the middle of the back and the setting of the neck are depressed, which gives a hump-like appearance to the interscapular portion of the ridge; but there is no true hump; yet, in consequence of this ridgy appearance, the animal stands four or five inches higher on the fore-legs than at the crupper, and the hinder part of that curves downward to the tail, which is slender and not very long. The front is square, broad and flat, the insertions of the horns being ten inches apart. The horns curve slightly outward and upward, while the ears, which are nearly of the same length as the horns, and slender in proportion to their length, droop down till their direction is nearly the reverse of that of the horns. The eyes are rather small in proportion to the size of the animal. Both sexes have a small tuft of white curled hair between the bases of the horns, which curls down upon the forehead. The dewlap is large and pendulous, and makes the portion of the neck next the head appear more feeble than it really is; it also gives an apparent depth to the chest, out of all proportion to its width. The abdomen is large, but contracts toward the groin, as if the body were slightly compressed by a girdle there. The udder of the female is small. The legs are thick and stout; the principal hoofs broad, and the false ones much larger in proportion than those of the domestic ox. The hair is very short, with the exception of that on the forehead, already mentioned, and a small bunch on the end of the tail. The colour is brown in various shades. The characters and also the habits of this animal resemble the ox more than they do the buffalo; but it breeds indiscriminately with either.

It is chiefly found upon the south-western and southern slopes of the secondary hills to the Himalaya, and on those to the south of the Burhampûtra. When in the wild state it is rather a woodland or jungle animal; but it is domesticated in large herds by the people to the eastward of India. It does not extend into the dry districts.

The Yak (*Bos grunniens* of Pallas) is not very accurately named by that naturalist, as its voice is a sort of subdued and broken low rather than a grunt. This is the mountaineer of central Asia, being found in the Himalaya and Altai ridges, and in the connecting ones, and their spurs eastward as far as China. It has been classed with the bisons, and in the northern extreme of its geographical range, it is understood to trench closely upon the habitat of the eastern one; but it is an animal domesticated to a very considerable extent; and its characters are more peculiar than those of many others of the genus. It has the same number of ribs as the bisons, and the forehead is a very little arched; but the resemblance between them extends little farther.

In the more elevated portions, it is rather a small animal, not above three feet and a half in height at the shoulder, and seven feet in length; but in its more fertile pastures it attains a larger size. In the form of its head there is a slight resemblance to the buffaloes; but the character of the horns is more that of the ox. They are lateral in their insertion, and do not advance toward each other on the frontal ridge as in these animals. One of the most peculiar parts of it is the tail, which is covered all over with long hair like that of the horse, only the texture of the hair is much finer. Their tails are in much request both in India and the Turkish Empire. In the former they are used for fanning off the flies, and among the Turks they are used as insignia of rank. They take a fine dye, the stumps are often richly and beautifully ornamented, and they have a very flowing and graceful appearance. When a bashaw of so many tails is mentioned, it means the number of the tails of the yak which he is allowed to have carried when he rides in state.

As has been already hinted, the varieties of the genus bos are exceedingly numerous, and they range over a very great extent of country both in latitude and in longitude. For the reasons which have been already stated, there is no possibility of exploring their progressive history and progressive geographical distribution in any thing like a satisfactory manner. But, so far as we can judge, mankind do not appear to have made any even very moderate advance in civilisation without pressing one variety or other of the genus into their service; and, therefore, we may expect to find traces of them wherever improvement has at any time been, whatever may be the condition of the place and the people now. If we are to take their central locality, or what we may designate their original head-quarters, somewhere about the north or north-west of India, where also there are more of the cultivated plants which are common to all civilised nations found in the wild state than perhaps at any other spot on the earth's surface, we should say that they have extended northward both in Asia and in Europe to the confines of the polar regions—to those places which once were perhaps the favourite abodes of the larger bisons, and of the northern elephant of a still earlier time. They have extended westward to the Atlantic both in Europe and in Northern Africa; and they have been carried by later adventurers across that ocean, till they have stocked both the northern and the southern part of that continent with more valuable animals certainly than any which it contained when the knowledge of it was first added to eastern geography. They have extended southward into Central Africa; and in Asia they have reached the larger islands which lie most contiguous to the shores of its middle and its eastern peninsula. But it is doubtful whether they reached those places during the time that they were wholly in the possession of that dark race who are called the "Oceanic Negroes;" and even the Malays do not appear to have carried them on their distant voyages; for there is no trace of them in the remoter isles of the Great South Sea; neither were they known in Australia, till it became an object of European settlement.

In the present state of the world there is not perhaps any one of the species or varieties, which are more properly designated oxen, to be found wholly in a state of nature, and not to some extent or in some way under the dominion of man. In proportion as those which more clearly appear to be of the same stock, whether that stock is to be considered as the production of natural circumstances wholly, or more or less modified by culture, have been the more readily spread over different climates, and among people of different habits, they are found to differ the most in the individuals, both in colour and in all their other external appearances; and in proportion as any one species or variety is more confined in its locality, or has the locality over which it ranges more uniform, whether in its own physical circumstances, or in the habits and degree of civilisation of its people, we uniformly find that all the individuals are the more constant to one general type. But their characteristic history is as extensive as their uses to man are valuable, so that we must leave them, with whatever reluctance, and briefly notice the section which contains the buffaloes properly so called.

The Buffalo section. The animals which form this section, though they have the general characters of the genus bos, have a considerable number of points of distinction; and they belong to a different geographical position. They are animals of the eastern continent only, and though, in what may be considered as the central zone of the genus, they are found both wild and domesticated, yet they do not reach the northern part, and in Africa they are found farther to the south than any of the others; and there are native species in those countries toward the farther extremity of that continent which the ox had never reached till carried there by European settlers. The three sections may thus be considered as, in their native distribution, lying in parallel belts along a zone stretching from north-east to south-west, the bison and the domestic ox being on the north side of the desert, and the buffalo on the south, though the localities of the ox and the buffalo mingle with each other on the banks of the great rivers by which the continuity of the desert is broken, as the Ganges, the Indus, the Euphrates and Tigris, and the Nile.

Domestication has, however, carried the ox into every place where the buffalo is to be met with, and even beyond it to the south in some places; and though the domesticated buffalo has been in fact carried into places which may more properly be considered as the localities of the ox, yet the interference in this way has not been nearly so great as in the other. This is easily accounted for, both from the haunts of the buffalo in a state of nature and from its disposition and habits, which render it far less fit for domestication than the ox. There is a slight approximation to the buffalo, both in haunt and in appearance, in some of those species or varieties which are oxen in their principal characters, and those are the varieties of ox found nearest the localities of the buffalo. The gayal, for instance, has a heavy and buffalo-like appearance, though it is not so expressive of strength as the latter animal. Now we mentioned that the favourite country of the gayal is the lower slopes of the Himalaya, toward the Indian side, and especially in the lower parts of the valley of the Ganges, in which places there is a most abundant vegetation, as the mountains pour forth innumerable springs which irrigate those places and keep them in a state of vigorous vegetation, at those times when the level plains in the same latitude are completely burnt up.

The gayals come to the border of the marsh in these places; the buffaloes enter it, and feed upon a much more rank and coarse herbage than any others of the genus bos. They eat the luxuriant but rough grasses with which the permanently humid spots in such a climate are always covered; and they seldom quit these naturally, even for those pastures which, during the rains, afford much more succulent food for grazing animals.

Though different in all essential respects as animals, the buffaloes and the elephants are neighbours, and often co-dwellers on the same grounds; and this holds in Southern Africa as well as in the lower valley of the Ganges, and along the banks of the other rivers to the east which discharge their waters into it, or into the Bay of Bengal. All animals are in part modified by the physical circumstances of the places where they reside; and however they may differ in genus, or any other division into which animals can be formed, if they feed on the same pastures, they acquire a sort of community of manners which mark them as the animals of that peculiar place rather than of any other.

This is so very general, especially in the mammalia, which, being more the tenants of the earth's surface than animals of any other class, are necessarily more influenced by the physical circumstances of that surface and of the air over it. So general is this character from locality, that it is found not only in wild animals, but in domestic ones, and even in man; and so powerful is the operation of those physical circumstances, that their effect is fully as conspicuously seen in the animals, as the circumstances which produce it are in general observation. Our observation of the productions of nature must always be comparatively imperfect, therefore, if we do not take this effect of locality along with us. Nor does it at all require great differences of latitude, or of climate as dependent upon latitude; for all circumstances which alter in any way the characters of a place, alter to the same extent all that are produced in that place, or that inhabit it; and in the case of the animals, those which are the most plastic to climate, and therefore the best for domestication, show it most conspicuously. Intercourse tends to lessen it, and those who are much in the habit of travelling, and who travel for business or for pleasure rather than for observation, are apt to become insensible to it, unless in cases which are very striking; but it is a power which should be carefully kept alive as the very foundation of knowledge, that is, of the intelligence which is the parent of knowledge, inasmuch as the whole of human knowledge, be it what it may, is either directly or it may ultimately be traced to a knowledge of differences. The chief difference between an intelligent man and a dull one is, that the former can see small differences and the latter cannot.

England is not the best country for seeing those characters produced by locality, because in England both man and animals shift about, and even the seeds and germs of cultivated plants are yearly changed from district to district, all of which changes tend greatly to the advantage of the country. But even in England there may be a difference traced between the inhabitants of any two valleys, and if those valleys open to different aspects or different seas the difference will always be more conspicuous; and if it be found more so in one, it will be found more so in all, whether natural or cultivated, if the latter have remained long enough to be affected by the local influence.

The buffalo and all the animals which inhabit the marshy or permanently humid places on the lower rivers of India, afford a remarkable instance of this; and the influence extends to the neighbouring plain. No matter for the class to which the animal belongs, for the locality is stamped upon its appearance; and to those who are well acquainted with the differences which known places produce, the animal of itself tells at once whence it comes. Even the cattle, as they approach these humid jungles, have the skin much exposed to the action of the air, and formed into folds in those places which are subject to much motion. The shape too has fewer angularities than in the inhabitants of dry upland pastures (this particular is remarkable in the human race). The whole body becomes heavier, more expressive of strength, but less of activity; the legs become stouter, and the feet broader. Thus from the bullock on the plains of India, we may trace a gradation through the gayal and the buffalo to the rhinoceros and the elephant. And it is worthy of remark, that the horns or armature of the head of the rhinoceros, though it is produced upon a different part, and has no core of bone, is formed of horn produced by the epidermis, and resembling, in the matter of which it is composed, the horns of the ox tribe. We could, therefore, easily fancy the rhinoceros to be a link connecting the herbaceous elephant with the herbaceous buffalo; and as being the last of the horned animals in coming down from the polar regions to the equatorial, just as the rein-deer of the eastern continent is the first.

There is one curious gradation in those horned animals, taking them from the rein-deer to the rhinoceros, which, properly worked out, might throw much light upon the relation between animal and climate; and thus be of great use not only in speculative natural history, but in the rearing of animals, and the increasing of their value in an economical point of view, without which natural history, pleasant though it be, is but a barren subject. And here we cannot help remarking that, however tedious the tracing of these general analogies may feel to those who look merely for the surface anecdote of natural history, and are incapable (of course because they are triflers in all matters) of entering into the spirit of them, yet it is because those analogies have not been attended to that natural history has failed in producing those practical results—those extensions of the dominion of man over the animals—those additions to the most productive power of wealth and comfort in all countries, which we have so much right to expect from it. We are aware that in this matter the prejudice both of the unlettered and the lettered vulgar is against us; but truth and reason are on our side, and in their train the analogies of all the sciences, in which the generalising of the observed facts and the tracing of the relations have evolved the law, which law once discovered speeds onward, as the beams of the sun, illuminating and warming as it proceeds, and turning even the pestilent fogs and vapours of the night into the immediate means of fertility and of health. We call upon the reader who is not accustomed to view natural history in this light, to think of what has been done for and by the science of astronomy. Mankind were star-gazing long enough before they began to attend to the analogies, and by their assistance to arrive at the grand law of the celestial motions; and what did they make of it? Why ridiculous blunders and superstitious fears and mummeries; nor was it till the ardent mind of Kepler, bent upon tracing the analogies or, as it was then called, seeking "the harmonies of the spheres," got hold of the observations of Tycho, as the proper instruments of his labour, that the several branches of the grand law of planetary motion were so much as named. This, however, was *the step*, and thenceforth observation ceased to be desultory, and became useful. Newton followed, and completed what Kepler had begun; and now there is not a man in civilised society who does not owe much of his personal accommodation to that giant effort of mind, neither is there one useful machine upon earth, no, not even the body of an animal, which does not work according to, and to a considerable extent in consequence of, the law of the heavens.

But if this has been the result of the discovery of one law, the centre of whose action (the sun) is at the distance of a hundred millions of miles, and which at most is but a law of dead matter, what may we not expect when science shall once fairly grapple with natural history, and the law of life shall be as well understood as the law of gravitation? There is no mystery in the one any more than in the other, save the mystery of ignorance, and, only 300 years ago, that enveloped the laws of motion far more closely than it at present does the laws of life. Gravitation is not matter, but it is a universal phenomenon of matter, and life is not matter, but animal life is a universal phenomenon of living matter. The two, therefore, stand in the very same predicament; and we have no more reason to despair in the one case than we had in the other. But as in the one instance so in the other, mere observing will not do; we must study all the relations, and they are far more numerous than in the other instance. This is the age of observation in natural history; our vigilant students are Tycho: may we soon hope for a Kepler to quarry the block, and a Newton to work out the statue.

The analogy which we have to mention is but a slight one, and cannot conduce much to the grand purpose; but on a subject where mere appearance has been almost every thing, and relation almost nothing, or the counterfeit of it (made by the idle fancy of the dreamer) less than nothing, the very smallest hint ought not to be lost. Now, in all these horned animals, taking them from the elk to the rhinoceros, there is an increase of the production of horny substance and skin, and a decrease of that of bone in the horn, and hairy covering upon the skin, as we proceed from the pole to the equator. The horns of the rein-deer and the elk are not true horns, but consist wholly of bone. The bisons have small horns; they are larger in the ox, and largest in those varieties which inhabit nearest the equator, as in the oxen of Abyssinia; they are larger still in the buffaloes, and in some of the species they form a horny plate of great thickness along the whole frontal ridge; and in the rhinoceros, the armature of the head consists wholly of horn without any bony core. So also the elk and the rein-deer have the bony covering remarkably close, but the skin of rather loose texture, and deficient in gelatine. The bisons, though their coat is longer, have it not so close, and their skins are more compact; the ox has the coat still thinner, and the hide firmer; the buffalo, at least the Indian one (and the one of Southern Africa is in a colder latitude) has the hair so very thin that it does not cover the skin, while the skin is the thickest among all the ruminantia; and the hide of the rhinoceros is almost naked, and nearly impenetrable by common weapons.

All animals which have the skin thus naked and thick are fond of walking in the mud and being in the water, and they are but ill able to endure the cold. The buffalo retains the obedience to climate which is characteristic of the genus to a considerable extent; but still it cannot face extremes of cold nearly so well as extremes of heat, and it is very partial to wallowing in the mud and swimming in the water. Farther, though the buffalo is a ruminant animal, it partakes of the sullen character of the thick-skinned tenants of its native jungles. It cannot be attached to man as the ox can; and though its strength and power of enduring the heat render it valuable for some purposes, it cannot be made the same general servant to man as the ox. When they are roused by danger, either to themselves or their young, buffaloes are very resolute in their attacks, and their style of warfare combines that of the ox and the elephant. They butt with the forehead, the large ridgy shields of bone upon which render the blow of an animal of so much weight very serious; they also toss with the horns, and it is when they succeed in the toss that they resemble the elephant; they kneel upon the fallen enemy before it can recover itself, and by the weight of their bodies press it to death. But an enraged buffalo, like an enraged elephant, is not satisfied with the mere killing of that which it attacks; it will return again and again, and gore and trample the remains till they are separated bone from bone. They retain this propensity even in the domesticated state, and when they observe any of the more formidable carnivorous animals, they rush boldly to the attack, and in situations where the beast of prey has no time to crouch and make his spring, the buffalos usually master him. Thus, it is only when a buffalo can be approached skulkingly, and generally when he is apart from the herd, that even the lion or the tiger will venture to attack him. When once the spring is taken, and the beast of prey has got his hold, he can master the strongest single buffalo, because those predatory animals always spring to a place where the prey cannot injure them, and they convert the very strength of the prey into a means of its own destruction; but if the herd are near and excited, the dead buffalo would be no meal for the lion or the tiger; the rest would instinctively set on him and finish him, just as the one of a pair of ravens will go in and finish a hawk, if the hawk pounces on its mate. Indeed, it is only when strongly pressed by hunger, and under circumstances very favourable to its purpose, that either the tiger or the lion will attack the buffalo.

Under ordinary circumstances, the buffalo is a quiet, and, to a very considerable extent, a manageable animal; but its chief use is as a beast of draught or of burden, or for its skin when dead. The milk can be used, but the flesh of the buffalo is rank and coarse, and thus it has not the same general utility as the ox to recommend it.

There are two species of buffaloes, the Indian, and the Cape, or South African. The former has been domesticated, spread over various countries, and of course broken into varieties, which differ from each other in the forms of their horns, and in several other of their minor characters, though they do so to much less extent than oxen. These varieties have often been described as species, and they have been called by different names, and names which are given to them in those countries where they are all natives; but popular language is a very unsafe guide in these matters. If an observer from Hindûstan were to make the tour of the districts of this country, and notice the varieties of an animal—a horse or a pig, for instance, together with the local names, he might return with his portfolio full of species and specific names, and much more must an observer in India be exposed to this deception. That there are wild buffaloes in India is not meant to be denied, any more than that there are wild and domesticated animals of other kinds; but the species is most likely the same in the buffalo, just as it is in the gayal and others. This is rendered more probably by there being considerable differences among the wild ones, especially in size, in development of the horns, and in boldness of character. The larger and more formidable ones are met with in the richer jungles, which may be considered as the best pastures; and it is very natural to conclude, that, from the superiority of their feeding and their being obliged to shift for and defend themselves from very formidable enemies, they must be much more ferocious than those which are under the protection of men, and have their spirit broken by labour. The white cattle of Tuscany are a very mild race in their pastures on the Arno, but their manners are very different in those places of this country where the remnants are left in a wild state. These have no doubt degenerated in size as much as they have increased in spirit, while the wild buffaloes of India are superior to the tamed ones in both respects; but the reason of the difference as to the size obviously is, that in the one case, the running wild, and in the other, the being domesticated, have been attended by a change of locality, of food, or of both, unfavourable to the animals.

Some notion of the general form and appearance of the Indian buffalo may be obtained from the following figure.

Indian Buffalo.

The Arnee, the variety which is found in the humid and luxuriant jungles, to the eastward of the plain of the Ganges, and also in similar pastures in various parts of the eastern peninsula—which peninsula has the advantage of the humidity of two currents of the sea, and is much more fertile than India, the greater part of which is watered only periodically by the monsoons—is much larger than that to the westward of the Ganges, and it is different in colour, though in animals of this genus colour is not a specific difference, but a difference arising from external causes, and greater exposure and inferior pastures are apt to change the colours of the genus. The height of this variety is said to be sometimes seven feet at the shoulder, and the chest is remarkably square and broad, forming in this respect a striking contrast with the gayal, though the colour of that animal differs, and its size is larger in rich and shady places. The hair upon this animal is said to be rather long, partially shaggy, and of a black colour, but it is so thinly scattered, that the skin, which has the epidermis white, appears through it. The face is broad and square, and the breadth continues with little interruption to the muzzle. The horns are truly gigantic, at least six feet long each in the larger specimens. They are wrinkled, triangular in the section, and when the line of the face is perpendicular, they bend outwards, upwards, and slightly forwards, but bend backwards at the tips. These appear very formidable weapons, and they are so in reality to some extent, but certainly not so much so as they appear. They are not offensive weapons for daily use, but rather defensive ones; and those animals, as well as all the horned ones, attack only as the best means of defence. They have no prehensile or tearing organs, like the carnivorous animals, and therefore, unless they can destroy the enemy, or ward off his attack by means of the horns, they must be vanquished. The muzzle in the buffalo is said to be the place at which the more formidable beasts of prey spring, in the same manner as a dog attempts to lay hold of a bull, and thus the horns are so placed, that they act most powerfully in guarding the muzzle. But in the ordinary and peaceful habits of the animals, the horns answer some very important purposes. These animals feed in the close jungles, where eyes are of comparatively little use; and though the ears, which are long and funnel-shaped, may be of service in enabling them to avoid hostile animals, or find friendly ones, they can be of no use in guiding a grazing animal to its food. Hence, the sense upon which they have chiefly to depend for their subsistence, is the sense of smell; and as the scent of their food comes in the air, and is not on the surface of the ground, as is the case with that of carnivorous animals which follow their prey upon the scent, they require to carry the nose elevated while they are ranging the jungles. In doing this, the horns act as powerful auxiliaries, as their weight assists in balancing the weight of the head when the line of the face is carried in a horizontal position, or rather with the muzzle more elevated than the ridge of the forehead. This is the general position of the head while they are walking in all the varieties of the Indian buffalo, whether wild or in a state of domestication. When it is so carried, they have not, of course, a very full or ready use of their eyes, and so, when they are alarmed, and make a halt, in order to have ocular proof of what may be the matter, the elevating of their great horns, especially if there is a herd of them, and they are very frequently in small herds, has a very formidable appearance.

Their horns are of use to them in another way. They are much in the water, not only for pleasure, when they seek to cool themselves, or wash off the mud in which they have been wallowing, but also for what may be called "business," that is, in crossing the rivers, and in making use of them for transport from place to place. There are seasonal changes in the pastures of these animals, even where they are the most favourably situated. The rivers flood when the rains are on the mountains, and when it is dry there they run low. These periodical changes cause a sort of periodical migration of the buffaloes, and in their descents especially they have recourse to the water, and float down apparently at their ease, till they arrive at those places which suit their habits. The manner in which they carry their heads in swimming may be seen by observing those which are represented in the water in the back ground of the figure above given. This aquatic habit is of much value to them when the season requires that they should change their pasture, as neither the places which they frequent, nor their own heavy bodies and short thick legs, are well adapted for long journeys upon land.

The *Arnee*, as found in the less humid and productive parts of India, is said to be much shorter than in the eastern jungles, though it is most likely the same animal—at least there is not any difference between them that can be considered as absolutely specific. These wild buffaloes of the plains of the Ganges (for it is said to be in the country places near that river where the greater number of them are found) are represented as being nearly as heavy as those in the eastern jungles, though lower. They are said to be nearly of the same colour, only the hair is shorter, and the skin not so white. They are further represented as being much more gregarious, and as appearing in herds of several hundreds, both on these marshy pastures, and when they are floating in the river. That they should be more gregarious in proportion as their pastures are wider, and there is less cover for the few enemies which they have cause to dread, is readily to be supposed. One animal may make its way through the jungle, but the passage of a herd of animals as large as the buffaloes would be rather a difficult matter. We find that, in the case of the antelopes, those which live in the forests are far more solitary than those which frequent more open places, and they are also far more bold and resolute.

The history of the wild buffaloes of India, like that of the wild oxen, wild dogs, and many other wild animals of the same country, is far from satisfactory; and it is of such a nature that the most careful inquiry which can now be made can hardly be expected to clear it up; and we never can enter safely upon the history of any one of its races, unless we keep the cause of those difficulties constantly in our view. India is not only a land of very violent natural action, as is proved by the facts, that much of it is worn to the granite, that some of the rivers flow through deep channels, even in the solid rock, for hundreds of miles; and that the lower parts of the valleys of others continue, for hundreds of miles in length, deposits of matter, evidently brought there by the waters, extending to the depth of several hundred feet. It is no exaggeration to say that the Ganges alone has, in the course of time, and without any other action than the common one of the seasons, washed down more matter than there is in all the British islands above the level of the sea; and while the Ganges has been doing this, the other rivers and means of change have not been idle. Land and water must thus often not only have changed places with each other, but have alternated on the same place many times over, and soil, with its plants and its animals, must have again and again been formed and swept away. Thus we may see in India, upon a tolerably large scale, changes and revolutions in the earth, and its productions and inhabitants, similar to those which, in countries where the common action of the elements is far milder, we can imagine to have been brought about only by some grand convulsion of nature. For, in India, they appear to have taken place without the agency of either earthquake or volcano.

Nor, if we compare the feebleness of man's resistance with what can be done by natural causes in such a climate, situated between the gigantic Himalaya on the one hand, and the ocean which stretches uninterrupted from Cape Comorin to the Antarctic sea on the other, can we consider that the changes produced by human means have been less in proportion. For nearly three thousand years, according to tolerably well authenticated history, or for four thousand years, if we are to believe the really not improbable history of the war of Mahabharat, India has been a prey to the sword of every conqueror, so that there is perhaps not a spot within it, even that pestilent barrier at the foot of the Himalaya, which says imperatively to man, "thou shalt not dwell here," which has not felt fifty alternations of fertile fields and lonely villages, with houseless jungles, in which not one memorial of man or his works remained. Those alternations take place with wonderful rapidity in India; and in the memory of many now living, much of the country immediately to the south of the Nerbudda, has been thickly inhabited and well cultivated, tenantless, and overrun by the productions of wild nature, and thickly inhabited and well cultivated again. In such a country, it were vain to speak with too much obstinacy of original races of animals, more especially if at all analogous to those which man has at any time had in a state of domestication. Nor can we confidently assert that such an animal as the Arnee may not be the remnant of a race once domesticated which took shelter in the jungles, in the same manner as many of the peculiar tribes of men that are found in the fastnesses of those forests and mountains are understood to be. This is a very necessary caution in the natural history of India, and we have availed ourselves of what appears to us the fittest opportunity of putting those readers who are not conversant with such matters in possession of it.

The *domesticated buffalo* of India has been pretty generally distributed over the south-western part of Asia, Europe as far as the Alps, and Africa to the northward of the desert. It is a large animal of nearly the same character and size as the average of the wild varieties, being about six feet and a half high at the shoulders, and eight and a half in length, but the size varies with the climate and treatment. The horns are not so much developed as in the wild ones; they are less triangular in their section, being rather rounded on the posterior side, though they have the angular ridge in front. The skin in this variety is dark coloured, and the hair short, like that of the wild ones on the plains by the Ganges; but it is said that those which have been domesticated to the eastward of the mountains which separate India from the countries sloping toward the eastern sea more resemble the pale skinned ones of the eastern jungles. When we say that the skin is white or dark, it must be understood of the epidermis only; because the hair is of nearly the same colour in all, and therefore we must suppose that so also is the true colouring matter of the skin, which is generally understood to be lodged in the mucous tissue, between the epidermis and the true skin, which last is muscular, and contains vessels. All therefore that we can infer from the lighter epidermis of these animals in the thick jungle, and the darker one in the exposed plain, is that this particular portion of the covering is in them peculiarly susceptible to the action of the sun and atmosphere; that this pale colour takes place something in the same way as it does in vegetables when they are *etiolated*, or blanched; and the deep colour comes on in the exposure, just as vegetables become green in the leaves when they are exposed to a moderate degree of light and heat, and are apt to turn to a more intense tint, such as red or purple, when they are more exposed and not killed by the exposure. The same consideration would lead us to suppose that the general development of the animal is diminished by the same causes which darken the epidermis, as not only the horns which, as more immediately connected with that integument, and as we may say, growing out of it, are smaller in those varieties which are dark, but that the general dimensions are inferior. The fact that the horns of these animals are considerably more developed in the moist and sheltered situations than in the exposed ones, is of some value toward a right understanding of those large horns which are often dug up in the marshes and woods (or rather in those places which appear to have been once humid and marshy woods) in Britain, and in other countries;—as the fact that the shade and the exposure produce differences in one race, affords a rational presumption that they may do the same in another, especially where the races are so nearly allied to each other in a physiological point of view, as those unquestionably are which belong to the genus *bos*. This view of the subject is so very new that we will not venture a positive opinion upon it; but it is worthy of serious attention to those who never find a horn of more than ordinary size in a peat-bog, without at the same time discovering a remain of a race of animals which has become extinct. The deepening of the colour in the cattle of our own country in exposed situations, appears to be part of the same law; and that the white cattle which have retained their colour for nearly two centuries, in a climate so much more severe than their native one, may be in great part at least owing to their having enjoyed the shelter of the woods. The change of colour in domestic animals is an exceedingly curious subject; it is one the investigation of which would in all probability throw much light upon the general principles of natural action; and there are no animals which present so inviting a field for it as the genus bos. But, unfortunately, this is a subject to which so little attention has been paid, that those who may study it must begin at the very beginning.

The life of the common buffalo is understood to extend, under favourable circumstances, to about four-and-twenty years; and the female is said to become fertile at four, and even to be so at twelve, bearing only twice every three years during the interim. The period of gestation is not very well ascertained, and it may vary with climate; but it is reported to last about ten months. At all events buffaloes are not so prolific animals as common oxen, and this is another point of inferiority, in a state of domestication.

The Cape Buffalo (*Bos Caffer*). We have left ourselves but little space for the notice of this species; and much is not necessary, as we have already adverted to the principal general points, and endeavoured to show in what direction the general analogies lie. A figure of this species is shown in the next column.

This animal, as may be seen from the figure, has the most formidable front in the whole genus *bos*; and its general aspect is shaggy and formidable. We need not describe the form of the horns, as that is exceedingly well represented in the figure; but we may mention that they are the most compact, and in their substance the heaviest of all the horns of ruminating animals, excepting only some of those of the antelopes. This animal is considerably lower than the Indian buffalo; but it is firmer, though shorter in the legs, rounder in the body; and though the beard and short mane give it a rugged appearance, the greater part of the skin is nearly naked of hair, exceedingly tough and firm, and of a black colour.

This is by far the most formidable animal of the genus. It has never been tamed, and the males are dangerous to come near; and, as is the case with domestic bulls, they are found much more dangerous when they run bellowing by themselves than when they are with the herd. In the dry season they frequent the woods and copses by the banks of the streams; though when the rains have brought vegetation upon the surface, they often come to the *karoos*, or plains; and, in accordance with what has been said of ruminating animals generally, they associate in much greater numbers there than when they are in the woods. When they are thus in numbers on the open pastures, they are not, unless when physiologically affected in the season, so apt to do mischief as when they are met with in the woods. One might perhaps explain this difference by saying that, in the open plains they are much more secure from enemies, as not even the lion himself, formidable as he is in Southern Africa, will venture to attack them there. Ambuscades are what they have most danger from, and it is in the woods that they are in danger from these. But as they have a very acute sense of smell, they can generally keep out of the reach of the enemy; and unless he has the advantage of the spring and the stratagem, he seeks other prey. All the genus have a dislike to red colours; and in the Cape buffaloes, this dislike is peculiarly strong, and puts them into a state of excitement, in which they are probably among the most dangerous of animals.

Cape Buffalo.

No attempt has, so far as we are aware, been made to tame the Cape buffalo. If that could be accomplished, he would be a very powerful animal; and he is more swift-footed than most of the genus, though he does not take to his speed unless when excited to it by the violence of his passions. There must be a way of dealing with him so as to get the better of his violence, which, bold and daring as it is, is only an instinctive means of self-defence; but the experiment would, if practised upon the adult animal, be highly dangerous.

How far those animals may extend to the northward of the Cape is not known, neither are we in possession of data sufficient for settling whether they are or are not the same race as the buffaloes of

India. There is no obvious chain of connexion leading from the one to the other; and there is a very considerable difference in the nature of their haunts, as well as in their appearance and dispositions. The Cape buffalo does like the waters, but he can subsist in much more arid places than those of the East. No conclusion can, in the present state of our knowledge, be drawn from it; but it is not a little singular that the gnu of Southern Africa should hold among antelopes nearly the same place in respect of shagginess, production of horn, and violence of disposition, that the buffalo of the very same part of the world holds in the genus *bos*. It is probable that there may be varieties of this species, or even other species of buffaloes in the interior of Southern Africa; and some museum specimens, or at all events painted representations, have been mentioned; but these we are not warranted in admitting into the catalogue of real animals. This genus is, for obvious reasons, one of the most interesting about which the attention of mankind can be occupied, and the analogies of its history are peculiarly worthy of attention; but the very same causes which render the knowledge of it so very desirable, heighten the difficulty of obtaining that knowledge in a satisfactory manner. Some notice of the musk bull, which has been improperly considered as belonging to this genus, will be found in the article Ovibos.

BOSSIÆA (Ventenat). A genus of ornamental Botany Bay shrubs belonging to the natural order *Leguminosæ*. Generic character: calyx of two lips, the upper one broad, round, bifid. Pod on a footstalk, flatly compressed, the margins thickened; seeds like beads. Several of these plants are elegant, and well worthy a place in every green-house collection.

BOSTRICHIDÆ (Leach). A family of insects of the order *Coleoptera*, and section *Xylophaga*, or wood-eaters, of Latreille. In the recent works of the latter author, the family is considerably restricted; but in his early works it comprised the *Scolytidæ*, a group of very destructive insects. As the arrangements of Dr. Leach and Mr. Stephens are founded upon the latter method of distribution, being, in fact, an adaptation of the classification contained in the "Considerations génerales" of the French author, we shall tread in their steps, observing only that the *Scolytides* are intimately allied to the wood-boring weevils (*Cossonus*), and that the *Bostrichides* are apparently allied to the death watches (*Anobium*, &c.) The family then, in its extended sense, is characterised by an oblong and cylindric body, the tarsi are simple, or with the third joint bilobed, the antennæ never with more than ten distinct joints (often with fewer), terminated either by a large solid mass, formed by the union of several of the terminal joints soldered together, or by three large distinct joints; the first joint is generally long and bent; the palpi are often very short, and the tibiæ are flattened and toothed at the edges. The family is divisible into two sections, 1st, the *Scolytides*, and 2nd, the *Bostrichides*.

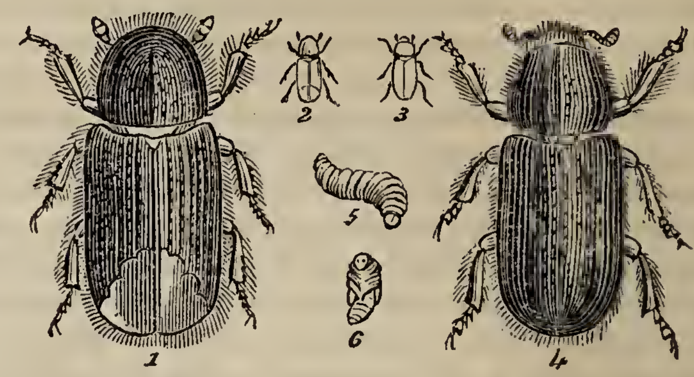
The *Scolytides* are distinguished by their antennæ terminating in a large compact oval club; the palpi are very minute, the body is convex and cylindric, and obliquely truncate at the extremity: the head is globose, with the front produced somewhat into the shape of a muzzle. This division comprises the genera *Hylurgus*, *Scolytus*, *Hylesinus*, *Tomicus*, and *Platypus*, all of which are British, and *Camptocerus*, which is an exotic genus. The ravages committed by these minute insects upon our standing timber trees is lamentable; indeed, it would probably be impossible to find any other objects of so small a size, capable of producing greater destruction. Probably there is no species of tree which is exempt from the attacks of some one or other particular species; moreover it does not unfrequently happen that several other species are found upon the same tree. It is to the ravages of one of these insects, that the elms, the pride of our metropolitan parks, have suffered so severely as to have caused a parliamentary inquiry upon the subject. This insect is the *Scolytus destructor*, distinguished generically by the compressed and rounded club of the antennæ, the truncate extremity of the body and the bifid penultimate joint of the tarsus; and specifically by its shining black colour, with the elytra reddish or pitchy, and the antennæ and tarsi of a pale reddish colour; the elytra are marked with longitudinal lines of raised dots. It is to be observed, that the destruction of the elms has not been attributed to these insects by several writers, who have considered them as consequent upon some previous indisposition in the tree, rather than as the actual cause of the injury. We must refer our readers to numerous papers relative to this part of the subject, contained in the early numbers of Mr. Loudon's Gardener's Magazine, observing only, that it is quite impossible to suppose that the facts subsequently to be noticed, can warrant any other conclusion, than that the insects must tend in a most material degree to the destruction of the trees, even if some already existing indisposition be admitted.

Who would believe, asks the German author Wilhelm, in his "Recreations of Natural History," that the little *Scolytus typographus* (another species nearly allied to the *Destructor*, but belonging to the genus *Tomicus*) is capable of totally destroying the finest fir trees, to which it restricts its attacks save in the last extremity? This insect has been long known in Germany, under the name of the black-worm. The great consistence of its envelope, enables it to withstand a degree of cold sufficient to kill millions of other insects. In the month of May, they make their way through the bark of the trees, beneath which they have passed the winter and acquired their full developement, and in certain favourable seasons they are so numerous, that in a warm evening when they take wing, they appear in swarms, and rise to a height in the air exceeding that of the trees; being carried away by the wind, and alighting at the distance of several miles from their native place. It is at the period of the emigration of these swarms, that the impregnation of the female takes place. On alighting, each couple goes in search of the rotten parts of trees newly felled, or, in default of these, they select perfectly sound and standing trees, in the crevices of the bark of which they commence gnawing a domicile, the situation of which is indicated not only by the powder which they produce, but by the noise which they make while at work. Latreille has observed on this part of Wilhelm's statement, that as the impregnation of the female has already taken place, it is probable that the male takes no share in the construction of a place for the deposition of the eggs. This indeed is a circumstance of such common occurrence amongst insects, although the reverse takes place in the majority of the higher animals, that the observations of Wilhelm have need of direct confirmation. At first a straight groove is perceived in the bark, on each side of which they burrow lateral channels, in which the female deposits sixty or eighty eggs ; each egg being placed separately in a small rounded cavity, which is then covered with saw-dust. After completing their labours, the parent-insects make their way again through the bark to the outside of the tree. At the end of fifteen days the larvæ are hatched, and immediately commence their work of destruction. They are small, soft, fleshy grubs, with short pointed legs, their body being divided into segments. Each of these grubs, starting from the place of its birth, constructs for itself a serpentine tubular gallery gnawed between the bark and the wood, and which, from the fanciful resemblance of these galleries to the letters of the alphabet, has given rise to the specific names of these insects, *typographus*, *micrographus*, *polygraphus*, &c.

Track of the Typographer Beetle.

These galleries never cross each other, but, by a remarkable instinct in the larva, run in diverging lines from the principal gallery, in which the eggs were deposited. Each gallery also increases in size, as it increases in distance from the centre, which is owing to the increased size of the grub. At the end of several weeks the larva attains its full growth, and changes into a pupa, in which state it is very tender and sensitive ; so that an unfavourable season destroys vast numbers in this state. And it is owing to the difference in the weather, that the duration of time passed in this state is increased or diminished. If the period of the full growth of the grub occur in summer, the insect passes through its various stages in the course of eight weeks ; but if the eggs are deposited in autumn, as many months are required for this purpose. Arrived at its perfect beetle state, it devours all the portion of the tree which remains between the wood and the outer bark, and finally escapes through the latter by boring a small circular orifice. If, therefore, a tree exhibits a number of these small holes, it is evident that the insects have escaped in their perfect state. Wilhelm states, that often times as many as 80,000 larvæ are engaged in the destruction of a single tree. The number seems immense, but when the minute size of the insects is considered (and they are much beneath a quarter of an inch in length), the statement may readily be credited. Another thing is equally surprising: even if the trees infested by these insects be cut down, floated in water, kept for a length of time immersed either in water or snow, or even placed upon ice, still the insects remain alive and unhurt.

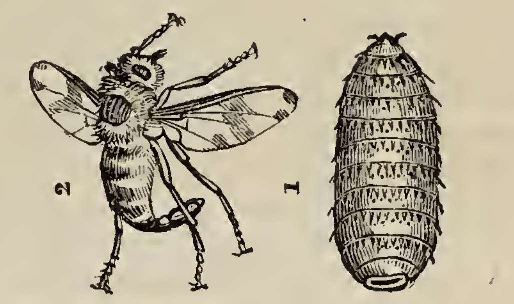
There are few of the large German forests which have not, at one period or another, suffered from the epidemic produced by the swarms of these insects, and which is there termed wurm-troekniss, and in the old liturgies these insects were mentioned under



their vulgar name of the turc. At the commencement of the eighteenth century, the Hartz forests were attacked, it reappeared in 1757, redoubled in fury in 1769, and increased until 1777 ; in the two following years it seemed to abate, but in the following year, after a hot summer, it increased to a most alarming extent ; the inhabitants were thereby menaced with entire ruin, by a total suspension of the working of the mines. The mischief arrived at its height in 1783, when it was calculated that on the Hartz alone, a million and a half of trees were destroyed by it. As the evil increased, the impossibility of applying remedies was augmented, since at this period the insects migrated in swarms, like bees, to Suabia and Franconia. A succession of cold seasons gave it a check ; but it re-appeared in 1790, and even in 1796 there was cause to fear for the few situations which had previously escaped. From these observations it was evident that the insects would not unwillingly attack sound and healthy trees, and Wilhelm observes, that the misplaced confidence which many persons entertained that the insects attack only trees already injured, and that their ravages are put an end to by the insects themselves, have cost many hundreds of trees. A small number of the bostrichi would not be sufficient to destroy a healthy tree, nor would they, except in favourable seasons, increase to an alarming extent; but it is always prudent, nay, absolutely necessary, to remove felled timber without delay, as the flowing sap is most attractive to insects. Carpenters also, for the like reason, should be prevented from erecting their sheds in or near forests. The trees once attacked, should be immediately cut down and barked, and the bark burned. Indeed, it is certain, that trees allowed to stand for a considerable time after they are dead, are neither fit for building, nor for fuel, nor for the manufacture of charcoal. The *Bostrichus ligniperda* instead of placing its eggs at each side of the principal gallery, deposits them all together, so that the larvæ work from a common centre, whence their burrows form a kind of star.

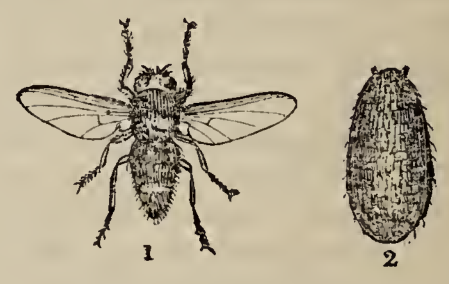
The second sub-family, *Bostrichides*, have the antennæ terminated by three large distinct joints, the palpi are of the ordinary shape, neither being minute nor conical. The tarsi have always the articulations entire ; here belong the genera *Sinoxylon*, *Apate*, *Bostrichus* and some others, to which Latreille adds the genus *Cis*, which Mr. Stephens places amongst the death-watches. The habits of these insects are somewhat similar to those of the other family, since they are constantly found under bark, in which they form cylindrical burrows, but they have never been observed to produce such mischief as the *Scolytides*.

BOT. The ordinary name by which the grubs or larvæ of certain species of dipterous insects, belonging to the family *Œstridæ*, or Breeze-flies, are known. The insects of this family are parasitic upon various quadrupeds, the larvæ residing and attaining their full growth within the bodies of these animals, inflicting great pain by their continued attacks ; and it is to be observed, that it is more especially those animals, which, from their domestication, have become of essential service to mankind that are infested, the cow, the sheep, and the horse, being in a more particular manner subject to these tormenting scourges, which change the little comfort which these useful slaves might enjoy during the summer months into perpetual torment. Considerable variation exists in the habits of the different species ; we shall therefore here restrict ourselves to those which attack the horse, and to which the term bot is generally confined, the larvæ of the species which prey upon the oxen and sheep being termed worbles, or wormalls. The history of these insects has been treated upon by several authors, Vallisnieri, Fischer, Reaumur, Linnæus, &c., but more especially by Mr. Bracy Clark, F.L.S., whose Memoir, contained in the third volume of the Linnæan Transactions (and which was subsequently published separately, with additions, under the title, "An Essay on the Bots of Horses and other Animals;" London, 1815, 4to.), has left little to be desired concerning the habits and economy of the different species. This gentleman (to whom the author of the present article is indebted for a series of specimens of these insects) was enabled, by tracing the flies through their various stages, to correct a curious error into which Linnæus had fallen respecting them. In the Systema Naturæ of the latter author, we find a species named *Œstrus Bovis*, but the description attached thereto is that of an insect which attacks the horses, whilst the habit of the species is given—" Habitat in ventriculo equorum, in boum dorso ;" (Vol. II., p. 969, edit. 12.) Thus it is evident that this distinguished author was entirely ignorant of the real *Œstrus Bovis*, and that the accounts which he had heard of that insect residing in the backs of oxen were considered by him to belong to the same species which he had also ascertained to reside in the stomachs of horses, "which," as Mr. Clark observes, "certainly never happens." If we, therefore, find such high authority as Linnæus stumbling over the habits and names of insects possessing such considerable claims to our interest, it is not perhaps to be wondered at, that the ignorant should equally fall into errors respecting them. Thus Blundeville, who wrote upon farriery in the reign of Queen Elizabeth, seems to have confused two different kinds of larvæ in his observation, "The second sort of worms have great heads and small long tails, like a needle, and be called *bots;* the third sort be short and thick, like the end of a man's little finger" (which we shall subsequently perceive must be our *bots*), "and be called *truncheons*." Dr. Johnson gives the ascarides as synonymous with bots ; whilst we find Shakspeare furnishing proof of the vulgar opinion current in his times, that these animals were produced from no other source than poorness of condition, an opinion resulting from the old and groundless doctrines of equivocal generation, which we have more than once alluded to. The ostler at Rochester, in King Henry the IVth, says, "Pease and beans are as dank here as a dog, and that is the next way to give poor jades the bots." That half-starved beasts must be more tormented by the half-starved bots in their stomachs endeavouring to obtain more food, is not improbable, and would render the poor jades still more jaded ; but that poverty, or bad food, would of itself produce these bots, is an assertion which we hope few at the present day would be credulous enough to believe ; since, although it is unquestionable that the generation of intestinal worms has always been a source of great difficulty, it is equally unquestionable that the bots arise from eggs deposited by a parent fly. Of these flies there are not fewer than five distinct species which are parasitic upon the horse. 1. *Gasterophilus Equi;* 2. *G. hæmorrhoidalis;* 3. *G. nasalis;* 4. *G. salutiferus;* and 5. *G. Clarkii.* These insects have much the appearance of drone flies ; they fly with great velocity, and make a considerable humming noise during flight. The instinct which they exhibit in selecting a proper place for their eggs is not exceeded in interest by any other insect. Of this, as exhibited by the *Gasterophilus equi*, the author of this article



Gasterophilus equi.

was a witness, in a meadow near Gloucester. We observed a large-sized fly hovering near a couple of horses, and having selected one of them, she approached it, still on the wing, her body being carried nearly upright in the air, with its extremity considerably elongated into a horny tube, which is extended nearly horizontally, and consequently nearly at right angles with the body. This fly chose the side and back part of the shoulder as her place of oviposition, but the inside of the knee and the extreme ends of the hairs of the mane are more generally selected, especially the former. Being anxious to capture this fly, we approached the horses, which had not exhibited the least signs of alarm ; but our approach disturbed them, and away they scampered. We, however, followed them, as they happened to take the direction in which we were going, and were not a little surprised to see that the parent fly, in her anxiety to place her eggs in a fitting station, had kept up with them, and which she continued to do for a considerable time, during which we drove these horses about the field. The mode in which the egg itself is deposited by the parent fly is thus described by Mr. Clark : "Suspending herself before the part where she designs to deposit her egg for a few seconds, she suddenly darts upon it, and leaves the egg adhering to the hair : she hardly appears to settle, but merely touches the hair, with the egg held out on the projected point of the abdomen ; the egg is made to adhere by means of a glutinous liquor secreted with it. She then leaves the horse at a small distance, and prepares a second egg, and, poising herself before the part, deposits it in the same way. The liquor dries, and the egg becomes firmly glued to the hair. This is repeated by various flies, till four or five hundred eggs are sometimes placed on one horse." Here two circumstances are observable; first, that, unlike the œstrus of the oxen, this fly instils no terror into the object of its attack; and, secondly, that as the grub when hatched, does not, like that of the ox, gnaw its way into the body of the animal, it is essential that the instinct of the parent fly should be exerted to the utmost, in the selection of those precise spots where its offspring will be secure of obtaining the means of conveyance into the stomach of the animal. Now the accomplishment of this exploit, for so we may well term it, presents an example of that reasoning faculty, as we may almost consider it, which certain animals amongst the lowest ranks of the creation exhibit in an extraordinary degree. That this is the case will at once be perceived, when it is stated that these eggs are placed only in those precise spots which the horse can lick with its tongue. After remaining in this situation for four or five days, the eggs are sufficiently ripe to bring forth the larvæ on the slightest application of warmth and moisture. "At this time," continues Mr. Clark, "if the tongue of the horse touches the egg, its operculum is thrown open, and a small active worm is produced, which readily adheres to the moist surface of the tongue, and is from thence conveyed with the food to the stomach. If the egg itself be taken up by accident, it may pass on to the intestinal canal before it hatches, in which case its existence to the full growth is more precarious, and certainly not so agreeable, as it is exposed to the bitterness of the bile. I have often with a pair of scissors clipped off some hairs with the eggs on them from the horse, and on placing them in the hand moistened with saliva, they have hatched in a few seconds. At other times, when not perfectly ripe, the larvæ would not appear, though held in the hand under the same circumstances for several hours, a sufficient proof that the eggs themselves are not conveyed to the stomach." We have seen that during the act of oviposition no alarm is created by the fly, nor is this the case subsequently, although the contrary is stated in "Insect Architecture," p. 409. Mr. Clark, indeed, expressly states that it is owing to the irritations of "*other flies*, such as conopes, tabani and muscæ, who, by settling on the skin, occasion a horse to lick himself on those parts, and thus receive the larvæ on the tongue and lips, and a horse that has had no ova deposited on him, may yet have the bots by performing the friendly office of licking another horse that has." As, however, Mr. Clark has stated, that the eggs, when ripe, often hatch of themselves, and that the larva without a nidus crawls about till it dies, we should be inclined to consider that somewhat of the irritation above alluded to may be occasioned by the motion of the grub amongst the hairs of the body. Of the great numbers of these insects which we have stated are deposited on the body of a single horse in the egg state, few arrive at the perfect state, being subject to numerous casualties, so that probably near a hundred are lost for one which becomes a fly; first there is the chance of these eggs being washed off by wet; others are hatched and not taken up by the mouth; others, when in the mouth, are crushed to death; some may pass into the intestines of the horse; and when full grown and fallen to the ground many may be trodden to death, fall into water, or be eaten by birds. If however they escape the dangers which threaten their early existence, they make their way to the stomach of the horse, where, in a degree of heat far greater than that of the hottest climate, 102° Fahr., they attach themselves in clusters, especially about the pylorus, varying in number from six to a hundred, fastening themselves by the small end of the body, with the assistance of two small hooks, which are not found in such species as reside beneath the skins of various animals. Here their food consists probably of the chyle; and Mr. Clark is of opinion that they are not so very injurious to the horses as is generally conceived. After arriving at their full growth, these larvæ detach themselves and are passed with the fæces, when falling to the ground they seek out a convenient spot where they are changed to pupæ, and in about six or seven weeks the fly appears, during the month of August. It is to be observed with respect to these insects, that Mr. Clark, who has given a very minute account of the larvæ, as well as of what he considered to be the pupæ of several of the species, was not acquainted with the real pupæ. It is true, that, previous to becoming flies, the insect appears of a very different form to that which it possessed in the larva state, but this change of form takes place in the covering of the larva, which becomes shorter and hardens, forming, in fact, a cocoon, in which the real pupa is enclosed, as is the case with many other flies belonging to the same order. The *Gasterophilus equi*, whose habits we have thus detailed, is one of the largest in the genus, being about two-thirds of an inch long; it is of a dirty yellowish colour, with the back of the thorax, and a line of spots on the abdomen (which is of a redder colour) black, the wings are white, with a band and two small apical spots of a dark brown colour. The other species in the genus whose habits has been noticed, *G. hæmorrhoidalis*, resembles the former in the form and habits of the larva; but the economy of the perfect insect as to the mode of oviposition is very different. Linnæus, on the authority of Reaumur (who derived his information from Dr. Gaspari), describes it as "*mirè per anum entrans*," a perfectly fabulous statement, which has nevertheless been repeated by many authors, and which seems to have originated from confusing this insect with the forest fly, *Hippobosca equina*, which sometimes gets beneath the tail of the horse. With respect to the mode of depositing its eggs, Mr. Clark observes, "the part chosen by this insect for this purpose is the lips of the horse, which is very distressing to the animal, from the excessive titillation it occasions, for he immediately after rubs his mouth against the ground, his fore legs, or sometimes against a tree. At the sight of this fly the horse appears much agitated, and moves his head backwards and forwards in the air, to baulk its touch



Gasterophilus hæmorrhoidalis.

and prevent its darting on the lips; but the fly watching for a favourable opportunity, continues to repeat the operation from time to time, till at length finding this mode of defence insufficient, the enraged animal endeavours to avoid it by galloping away to a distant part of the field. If it still continue to follow and tease him, his last resource is in the water, where the œstrus is never observed to follow him. At other times, this œstrus gets between the fore-legs of the horse whilst he is grazing, and thus makes its attack on the lower lip; the titillation occasions the horse to stamp violently with his fore-foot against the ground, and often strike with his foot as though aiming a blow at the fly. They also sometimes hide themselves in the grass, and as the horse stoops to graze they dart on the mouth or lips, and are always observed to poise themselves during a few seconds in the air, while the egg is preparing on the point of the abdomen."

The *Gasterophilus nasalis* of Linnæus (Œstrus) is described by Mr. Clark under the name of *Œstrus veterinus*.

BOTANY is that science which includes the study and investigation of the vegetable kingdom. To describe and enumerate plants, to give to them their proper names, to mark their habits, physical differences and qualities, to arrange them into divisions by their organic structures, into tribes by their most ostensible characters, into families by their affinities and essential synonyms, and each individual of the families by its specific distinctions, is the business of the practical botanist.

Systematic botany was first projected by Conrad Gesner above two centuries ago. In the course of time the science was gradually improved, particularly by Tournefort and his cotemporaries; but it was reserved for the celebrated Linnæus to concentrate and reduce all that had been written before his time into his ingenious though artificial sexual system. Before the appearance of this new system, that of Tournefort was chiefly received and studied, and, though imperfect in many particulars, it had many excellencies, especially in preserving several of the true natural orders entire. Linnæus himself it seems felt the propriety of such an arrangement of plants, and had before his death made some progress in sketching a natural classification, but did not live to render it in any way complete. The idea, however, was not lost, but was approved and strenuously embraced by the indefatigable Jussieu, who, seeing the defects of the sexual system and the superiority of that of Tournefort, set about re-arranging the latter, and has by dint of great labour and extensive botanical knowledge, laid the foundation of a system which, with subsequent corrections and amendments of other botanists, comes as near to perfection perhaps as such an attempt can possibly be; for nature, notwithstanding she presents some very striking features of similitude in vegetable forms and structure, yet in general the diversity of external figure and conformation is so great and unlimited that many of Jussieu's groups must necessarily be small, and the number of the groups greatly increased in order to embrace every plant, and yet not depart from the grand principle on which the natural system is founded.

In presenting to the reader a general view of this interesting portion of natural history, it will be necessary, before treating of systematic botany, to describe the physical members of plants, that is, those different parts or organs which compose the vegetable frame, their apparent uses or functions, the character of their various membranes, their duration, decay, and reproduction, together with the nature and motion of the sap. In the prosecution of this detail, we shall have occasion to notice every grade of vegetation hitherto described, so that the reader may have as comprehensive a view of the whole as can be exhibited within the prescribed limits of a cyclopædia.

Before proceeding with a description of the various members of a plant, it is in the first place necessary to convey some idea of the membranes of which they are composed.

Vegetable membrane. This is one of the results of Almighty creative power, which, by the concentration or union of pre-created elements, called into form every plant whose seed or power of extension is in itself. This membrane is composed of innumerable distinct vesicles, variously arranged with respect to each other; each having a thin pellucid elastic integument, originally uninflated and inconceivably minute, but capable of being distended to a limited size, but in a definite order incident to the plant to which they belong, and in any direction. Leaning closely on each other, the cells are pressed into the various figures of spheres, spheroids, elongated cubes or ovals, forming the specific organic structure. There are also intercellular spaces which serve for the conduction of fluids or depositories of the secretions of the plant. Of this membrane every part of the vegetable is formed; it being capable of extension into filaments and fibres, fig. 1; spread out into tissues,

Fig. 1.

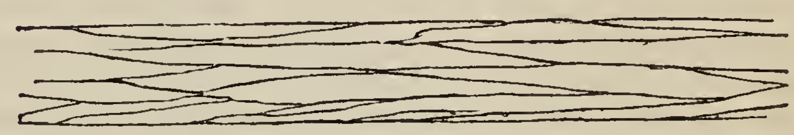
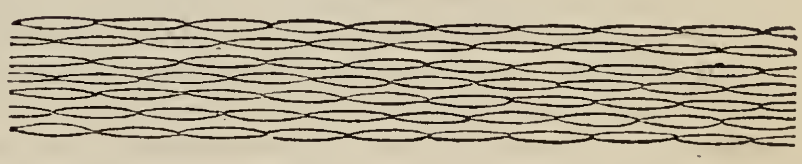


Fig. 2.

fig. 2; depressed into horizontal layers, fig. 3;

Fig. 3.



compressed into perpendicular partitions; or disposed in regular columns. When it is uniform in consistence and arrangement it is called *cellular;* when varied by being disposed in tubes, fibrous bundles, or other organic forms, it is said to be *vascular.*

In describing a plant it is usual to begin with the root, but as a seed or some dissevered part of a plant must exist before roots can be produced, it may be as well to begin with the description of a seed, because from it springs every other member which we shall have occasion to notice in the sequel.

Seed. Seeds are the oviparous offspring of plants. They are discharged spontaneously from the parent in a dormant state, except in some few instances which will be adverted to hereafter; but, with these exceptions, they may remain for ages uninjured. They contain a vital principle or embryo, which, when developed under favourable circumstances, is in all respects like the parent, unless art has interfered to change its form or qualities. When seeds are ripe they are shed from the capsules or from the other parts to which they were umbilically attached, and are then covered with one, two, or three integuments to preserve them till the season arrives, when other favourable circumstances conspire to produce germination.

A perfect seed is one of the most wonderful productions in nature! It contains a living principle within an organised body of cellular membrane capable of indefinite expansion. An acorn has been said to comprise the rudiments of every member of the largest oak. When placed in the soil, the fluids within are excited into fermentative action by the impact of heat, air, and moisture, in due degrees. Expansion of the membranes takes place, the outer coverings are burst asunder, the rostel of the awakened plantlet escapes away from dry air and light, descends in search of humid and gaseous elemental food, and fixes itself in the earth. Soon after the apex of the ascending axis shoots upward, pierces the surface, and expands in the air.

The vital embryo is attached to one or two lobes of nutritive matter, destined to yield sustenance to the infant plant while it is establishing itself in the ground. In doing this office these reservoirs of nutrition either remain undeveloped in a shell, as the cocoa-nut, within the surface of the ground, as the common bean, or are raised with and upon the ascending stem, as exemplified in the cucumber, the garden balsam, &c.; when thus developed they receive the name of seed-leaves (*cotyledons*).

Were it conducive to any useful information, a great deal of curious matter might be quoted here relative to the growth of seeds, from their first appearance in the seed-vessel (*ovarium*), until the time when they are ready to drop from it. Such investigations have been made by botanical physiologists, who, by the assistance of the microscope, have shown very satisfactorily the progressive generation, or rather gradual development, of seed, both before and after impregnation; but for such information we must refer to those authors who have written on that branch of botany called *Carpology*, and to the descriptions and figures of the seed-vessels hereafter given. Suffice to add here that the seeds of plants, like the ovæ of animals, are formed along with the vessels which contain them, and of course long before impregnation.

The general form of seeds is ovular or kidney-shaped; some remarkably compressed, others depressed, varying in size from an inch or more in diameter to an atom hardly perceivable by the naked eye. Some are provided with appendages for defence, others with spiral awns, or little hooks, or wings, to assist their dispersion. All are enclosed in a thin film of cellular tissue, and this protected by a covering of chaff, by a woody shell, or by a membranous or leathery coat of dense cellular matter. These again are frequently contained in pulpy, or fleshy, or rigid vascular husks. When discharged from these integuments they are of many different colours, as black, or white, or brown of various shades, purple, and some are beautifully scarlet, and used as ornaments. Almost all naked seeds have a mark or scar (*hilum*), sometimes prominent or depressed on the exterior, showing where they were attached to the seed-vessel or to its partitions (*dissepiments*), or to the receptacle of the seeds.

Although seeds, in all cases, are the real offspring or progeny of plants intended for the perpetuation of the species, and in this sense may be called also the fruit of plants, yet botanists have made a distinction between seed and fruit, and not without reason, because the latter is only the exterior covering of the former. The mark of distinction is this: whenever a stigma, or remains of its style, appears on the exterior of any production succeeding the flower, it is a fruit; but if no such mark or remains of a faded style be visible, it is a seed. By this rule, the common orchard apple, with the visible remains of the flower at the top, and the dry leathery capsule of the poppy, with its permanent stigma, on its apex, are both fruits; so the long husky pod of the common broad bean, and the delicately beautiful pendent globes of the cherry tree, are equally fruits. The very large and very small seeds of the second and third of these plants present no such exterior mark or appendage at all similar.

It has been already observed, that the internal substance of some seeds are either farinaceous or albugineous, and that these are destined for the support of the infant plant (as the chick is in the egg) before its roots are fully fixed in the ground. Such substances are entirely absorbed by the plant during the first stage of its growth, and in but few instances expanded as distinct bodies to do the office of leaves. Other seeds are entirely filled, with the cotyledons curiously folded up within the integuments, and when set at liberty by the bursting of the shell, or outer coat, they come forth in the air, expand, and seemingly act like real leaves. They are, however, only temporary appendages, as in most cases they quickly drop off.

The foregoing descriptions of seed relate only to those plants called dicotyledons, that is, such as have two seed-leaves, and monocotyledons, having but one seed-leaf. But there is another class of plants, called acotyledons, which have no seminal leaves, and consequently the structure or organisation of their seeds (*sporules*) are very different from those already mentioned. Instead of the resemblance to an egg, having an embryo enclosed by, or surrounded with, farinaceous or albugineous envelopes, as in the dicotyledonous plants, they rather appear to be viviparous particles separated from the mother plant, exserting roots or shoots indifferently from any and every part of them. But as these are only microscopic objects, their modes of germination, or rather the manner of their self-extension, is but imperfectly understood.

The Root. A root is first an undivided spur-like body, descending directly into the earth, either attracted by its moisture or solidity, or averted from dry air and light. The extreme point of a radicle is elongated chiefly by the protrusion of its centre, and in some degree by an increasing of its length, the exterior cuticle being left behind, while the internal part is momentarily progressing forward; the point itself being extremely delicate, would be instantly checked or withered if exposed to dry air. This constitutional delicacy may account for the prone direction of roots in the first place, or at the first setting off; because, as soon as they have gained a certain depth, they proceed laterally as readily as they descend. Indeed, a certain degree of influence of the air seems to be necessary to them: as the roots of some trees take a very extensive horizontal range, keeping at a very regular depth from the surface, however unequal this may be, even from one side of a ditch to the other, without varying much in distance from the air.

The roots of an air plant (*Aerides*) hung up in a moist hot-house, all tend towards the back wall, or to the nearest solid body. A growing plant bound to the periphery of a wheel, kept constantly in motion, directs all its roots to the centre or nave of the wheel. The attraction of the solids seems to be the cause of the inclination of the roots in both these cases. Roots are attracted by water, or by those elements on which they feed; manure laid on the surface will cause working fibres to rise; and in dry seasons they will descend deeper in search of moisture.

As soon as the first spur-like root issuing from a seed enters the soil, it emits small fibres from its point and along its sides; some of these become branches, which, in their turn, also eject fibres along their whole length; these are again divided and subdivided, until the whole system of roots is formed, and thus they continue annually extending as they are prompted by the demands of the head. The roots and head of the plant are *correlative*, and are always naturally proportioned to each other. No extension of the one can possibly take place without a corresponding extension and enlargement of the other.

The fibres (*spongioles*) are the real roots or mouths of the plant, by which they imbibe or extract nourishment from the earth; for, though it be perfectly reasonable to suppose that the spongy bark of the larger ramifications also imbibe alimentary matter, yet to the working fibres is the system chiefly indebted for the principal share of the nourishment required. These delicate bodies are beautifully organised, and well fitted to take up those gaseous and aqueous elements necessary to the plant; their syphon-like form, beset with hair-like appendices, enter into every cavity and interstice of the soil in search of food, which these convey into the body of the root; and it is observable, that they are more or less numerous according as the plant is more or less vigorous. In water, or in finely comminuted soil, they are much divided, and are ejected like tufts of hair from the ends of the principal divisions of the root.

Fibres can only be produced in the earth or water, or in any other humid medium. Proper roots are often produced in the air, as may be seen on the cherry-tree, the grape-vine, and many other plants, when placed in damp or shady situations. The Indian fig, or banyan tree, is celebrated on account of its tendency to produce and throw down roots from its branches, which, fixing in the ground, become stems to support a new birth of branches which rise from that part of the branch whence the root has descended. Such roots, however, produce no fibres, because, as before observed, they are too delicate to be exserted in dry air.

There is no question but that these roots, though destitute of spongioles, have the power of inhaling through their vascular bark those qualities floating in the air which are adapted to, and necessary for, the amplification of the plant.

Although the roots of a great majority of plants are produced below the collet, or base of the stem, they may also be produced from almost every part of the stem or branches, sometimes naturally, as above alluded to, or accidentally, as in the case of a fallen tree, or by art, as takes place in propagating by cuttings and layers. Of roots there are many modifications, differing chiefly in form, and probably in their manner of acting as recipients of food. Bulbous-stemmed plants have generally fleshy roots, with but few fibres, acting in the earth as the air-plants and other fibreless roots do in the air, viz., by absorption through the pores of the cuticle.

Some plants, as the peony, have, besides fibres, large fleshy appendages, which not only serve to fix them in the ground, but to serve as reservoirs of moisture during severe drought. It seems to be a general law of nature, that all plants assailable by drought are furnished with bulbous or tuberous stems, or appendages to enable them to resist its effects.

In botanical books, roots are designated by proper names viz., bulbous, of which there are three,—the scaly, the coated, and the solid; to which are added the duplicate, the articulate, and the caulinar. There are also tuberous roots distinguished from each other by their form, or by the manner of their connexion, namely the globular, the truncated, the spindle-shaped, the handed, the bundled and several others. The writers who first proposed such distinctions, evidently meant nothing further than that that part of the plant usually found in, or resting on the ground is the root; because an onion or a potato can no more be called the root than any other part of the stem which happens to be elevated in the air. The proper functions of a root are to draw nourishment from and fix the plant in the earth, neither of which are performed by bulbs and tubers without the assistance of real roots put forth from the body of the bulb or tuber, or from a member quite distinct from what is called a bulb or tuber.

With regard to the permanency of roots, they partake of the character of the plant to which they belong. Those of annuals die with the plant at the end of summer. The main roots of trees and shrubs are as lasting as the stem and branches, but the fibres produced upon them are more fugitive, in many cases dying at the end of the growing season, and renewed in the following autumn or spring. This is very apparent in the case of bulbs and many tubers: and it is worthy of remark, that there is much agreement in the times of appearance and disappearance of the leaves on the branches of a tree, shrub, or herbaceous plant, and the fibres on the roots; they are produced simultaneously and fall off together.

Compound plants, that is, such as perennial herbs and some sorts of shrubs, being formed of many divisions, have not a common root; each division has its own roots, and may be slipped off without injury. Every new addition of shoots or leaves is produced by a new set of working fibres.

Some parasitical plants, as the misseltoe, have no visible fibres; their attachment to the plant they live on, seems to be an union of the cellular membranes of both. Others, as many of the tropical orchideæ, appear to use the stems of trees as supports, but without extracting from them any aliment whatever.

The foregoing observations are intended to identify what are really roots from other parts with which they are sometimes confounded. Under-ground stems are often called roots; such as those of couch-grass, the potato, and other plants which increase themselves by under-ground runners.

The structure of roots is very similar, whether succulent or woody. They all have a central member, formed of longitudinal fibres bedded in cellular and vascular matter, but without any pith. This central body is increased by annual additions to its exterior, in the same manner as the woody axis of a tree is increased. It is also covered with various layers of cuticle or bark; but which are always thinner, softer, and more spongy than that which is exposed to the air. The roots of some trees, as the elm and white poplar for instance, appear to have the same structure (except in being pithless) as the stems, and moreover are also furnished with buds, which shoot and form suckers all round, and at considerable distances from the trunk.

Roots of trees are more durable than their heads; and this, perhaps, because they are less exposed to the vicissitudes of weather. Although they generally die soon after the stem is cut over, yet there are many exceptions, as in the case of the two kinds just mentioned; and there are some remarkable circumstances on record relative to the longevity of roots. It is well authenticated that the roots of a mulberry tree when grubbed up, were found fresh and sound, though the tree had been felled forty years before! And from what has been lately observed by an eminent French botanist, the roots of the silver fir not only live for several years after the butt is dissevered, but actually increase in bulk: thus showing that the vital membrane, or that layer which is always seated between the bark and the wood, retains the power of enlarging itself, although there are no shoots to excite it into action, or outlet save its own expansion.

Attending to the development of a seedling plant, we cannot fail to observe that there is a point between the descending and ascending members which seems peculiarly organised. Whatever enlargement or ramification of the axis takes place in the first stage of the life, below this point, are roots, and descend; and whatever is above, are shoots, and rise into the air. This point bears the cotyledons, or seed-leaves; it is the crown of the roots and the base of the stem. In bulbs it is called the radical plate, fig. 6; of herbaceous plants it is the crown, fig 7; and of trees and shrubs it is called the life-knot, or collet, fig. 8.

This member is constitutionally of the greatest importance in the system; all the other members of the plant may be destroyed or separated, without risk of killing the plant, if the collet only be preserved. In some cases it may be divided into many parts, each of which will become perfect plants. Every scale of the bulbs of the common white and orange lilies, if pulled off with ever so small a portion of the radical plate attached, will each, if placed in the ground, become entire plants. In all bulbs, many tubers, and all other herbaceous plants which have not under-ground stems, the radical plate or crown is the centre of vitality, from whence all accretion, whether of roots, stems or leaves, proceed. All the productions of former years arose from it, and have withered away; and all that shall be produced must spring from that slender body—the radical plate of a hyacinth or tulip bulb.

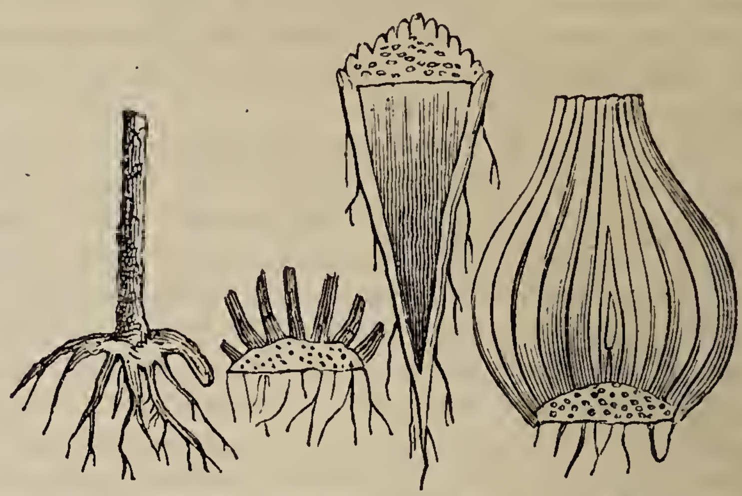


Fig. 8. Fig. 7. Fig 9. Fig. 6.

Sections of different Plants, to show the Collet.

If we examine this wonderful member we find it a homogeneous, solid substance; not granulous as we may suspect it to be, like the ovarium of an animal; but from its power or property of throwing off an endless train of perfect individual plants, we must consider it to be an aggregation of vital gems which are developed in the order of their position. The most central bud or gem generally takes the lead; but if this be damaged or checked by accident, or if it cannot appropriate the whole of the vigour derived at any one time from the roots, the next gem in order will be advanced, and perhaps one, two, or three of the lateral gems will be ejected, these when they do so appear, are called off-sets. In every year of the existence of a bulb we see the radical plate produce new roots, leaves, flowers, and seeds, all of which when the last are ripe, fall off, and are for ever separated from the mother plant. A successor in the mean time comes forth, occupies the space of the former, and is matured by the summer heat to be fully developed in the following year. In this way is the plant perennial, from its principal member being a source whence flows in infinite succession its annual products; and so it continues to do, as long as the plant remains in a sound and healthy state. Herbaceous plants in general not only produce an annual growth of leaves, flowers, and seeds, but also viviparous progeny parted off from the edges of the crown, which however is not thereby diminished, as is the case with the narcissus. Others, when they are surrounded by numerous offsets die off, leaving the space to be occupied by their offspring: of this description is the strawberry.

In many kinds of trees, especially those which have buds situated on, and which send up suckers from the roots, the collet becomes merged in the trunk and no longer conspicuous. In others it may always be identified as being more swollen than that part of the stem immediately above it. In the plant called elephant's tongue (*Testudinaria elephantipes*), the great body of the plant is only an uncommonly enlarged collet or ligneous tuber, fig. 9.

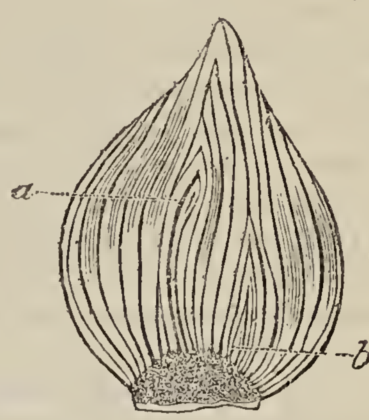
Of the Stem or Trunk. The stem or axis of a plant is that columnar body, which if above ground, serves to support and elevate the fructification. It assumes many forms and characters, as to bulk, structure, position, place and duration. It appears as a tuber a bulb, a scape, a culm, or as a woody column. It varies in size from that of a bristle to a trunk of many feet in diameter. In structure, stems are hollow or solid, jointed or simple, single or numerous. In position they are erect, inclining, prostrate or involving. They rise in the air, creep on the surface, or enter deep into the ground. They are succulent or woody: if the former, they are quickly perishable, if the latter, they are more or less durable.

Tuberous stems are exemplified in the iris and potato. The first is a stem, branched or single, partly beneath the surface of the ground, from which the real roots are ejected; and partly above the ground, the top bearing the leaves and flower stem. The second is a plant which, whether propagated from seeds or cuttings, has a system of fibrous roots on which the whole depends for support. The plant produces stems of two descriptions, one in the air which bears the foliage, flowers, and fruit: others in the ground, which, when they have shot a few inches from the root, instead of being lengthened out, stop—the point swells, and becomes a tuber of a larger or smaller size, according to the richness of the soil, or variety cultivated. When the seeds are ripe the whole plant dies, leaving the oviparous progeny perfected in the air, and viviparous offspring matured in the earth, to perpetuate the species. The tuber has a large farinaceous pith, covered with a thick coat of the like substance, and a thin exterior cuticle. Those integuments are studded with groups of buds or eyes, independent of each other, over the whole surface, and particularly at the point or crown. Each of these groups, when dissevered with a portion of tuber attached, become perfect plants, and again in their turn produce other seeds and tubers. A plant with such powers of reproduction, and in its native climate, must soon usurp the surface of the surrounding country, did not their numbers, by diminishing and robbing each other, confine them to very limited spaces.

There are many other plants similarly constituted, that is, such as produce stems in the ground, as well as in the air. Of these may be mentioned the Jerusalem artichoke (*Helianthus tuberosus*); the field bindweed (*Convolvulus arvensis*); the couch grass (*Agropyrum repens*), &c. There are also aquatic plants, the principal stems of which are extended in the mud, as the water lily (*Nymphea*).

It is worthy of remark here, that plants which have the property of increasing themselves by both seeds and offsets, produce the one in greater abundance, where means have been taken to prevent an increase in the other. Thus for instance, the potato denied its purpose of producing seeds by being deprived of its flowers, the tubers in the ground will be much increased, as well in size as in numbers. On the other hand, if the young tubers be removed from the plant as soon as they are formed, and none allowed to be perfected, the numbers of flowers and seed will be greatly increased. So rare or curious bulbs, which yield flowers, but do not ripen seeds in a climate foreign to them, may be forced to produce offsets by denying them the means of flowering, that is, by cutting off the upper half of the bulb. The same law of nature is exemplified in the English elm, which in this country bears no seeds: but to compensate for this defect, produces annually abundance of suckers.

A bulbous stem has the collet for a base whence the roots are produced; on the upper disk of the collet the leaves are seated involving each other round the centre, the exterior ones incrassated, abbreviated, and remaining for a longer or shorter period of time as a defence to the fructification before its expansion. The roots, leaves, stalk, flower and seed produced in this year are all deciduous, and fall off to be succeeded by the next division of the system, which will be developed in the next. As an example we may take the tulip, figured beneath.



Section of a tulip bulb in autumn—*a*, the flower of the following spring; *b*, the succeeding division of the bulb which is perfected during the summer.

In other bulbs, as the hyacinth, polyanthus—narcissus, there are always two or more divisions of the bulb coming forward together in different stages of their progress towards flowering: consequently these bulbs are always larger than those of tulips, or others of more simple character.

There are many modifications of this kind of stem. Some are very slightly bulbous, as the leek and blue African lily; others much expanded, as the Spanish onion and some of the Cape bulbs. The thick gouty stems of the crinum and aletris appear to be only the remaining bases of former leaves.

The internal structure of the bulbous stems is different, according as the leaves of the plant are placed with regard to each other. This may be rendered evident, by making a transverse section of the bulb: the outermost leaf partly or wholly embraces all the innermost, one of the edges overlapping the other, but without adhering, as in the leek; the onion having fistular leaves the coats of the bulbs are entire. This description of bulb is said to be *coated* (*tunicatus*). Another difference of structure is exemplified in the common white lily and other liliaceous plants; the exterior of the bulbous body being composed of thick fleshy scales attached to the radical plate: hence these are called scaly bulbs (*Squamosus*). A solid bulb has also been described in old books, and the tulip has been pointed to as an example, but this is an error: the tulip is a coated bulb; nor has there been any bulb of that description yet discovered.

A scape is a stem which springs immediately from the radical plate of a bulb, as the daffodil, or from the crown of a herb, as the primrose.

A culm is a hollow stem, either jointed, as most of the grasses, or simple, as some of the rushes.

The above enumerated stems are mostly succulent, and either hollow, or filled with a soft cellular pith, the exterior being formed of a fibrous cylinder, charged with parenchymous and vascular tissue, and covered with a thin transparent cuticle. The greater number rise erectly in the air or water; some creep along the surface of, and others enter deeply into the ground.

A ligneous or woody stem supports the branched heads of shrubs and trees, and is composed of three principal parts, viz. the pith, the wood, and the bark.

The Pith. This member occupies the centre of the stem, and constitutes the principal part of the bulk of the seedling, and of every young shoot. It is more or less filled with a spongy matter, easily permeable by fluids. There seems to be no action in the pith, except as a duct, after the first year; for, as it increases in age, it decreases in volume, and in old trees becomes almost obliterated. This central member is inclosed in a sheath, to which, if it be a dicotyledonous tree or shrub, the first concentric layer of wood is attached. In hollow stems, pith is only found at the articulations; and in jointed stems, which are solid, it is somewhat interrupted at each joint.

The above remarks refer to the stems of dicotyledonous plants; those of the class monocotyledoneæ have no regular pith, this being suffused throughout the whole body of the fibrous stem.

The Wood. The first layer of this principal member of a stem is simultaneously produced with the pith which it surrounds. During its growth it appears in three different states; at first, it is like thin colourless jelly, in which state it is called *cambium;* next, it gains a subsistence like gum, showing faint signs of organisation; and lastly, as perfect wood, called *alburnum,* having all the fibrous structure, cells, tubes, and consistence of timber. In this manner the diameter of all dicotyledonous stems are annually enlarged by concentric layers, the pith being in the centre of the whole. These layers of wood are composed of a mass of ligneous fibres, closely and longitudinally arranged, extending from the collet or base to the summit of the trunk, and to that of every branch of the spreading head. The fibres are embedded in dense cellular matter, the cells of which are placed horizontally between the bundles, and, being distended in the line of their position, give thickness to the alburnous layer.

As these layers are perfectly distinct from each other, there being no fibrous INTERJUNCTION, but merely cemented together by cellular matter and concreted sap, it is necessary there should be some common tie by which the whole column of concentric layers should be held together. This is accomplished by the convergent partitions of dense cellular matter, which reach from the bark to the pith in right lines through each layer. These perpendicular partitions are called "silver grain," and are those wavy lines so visible on oak timber when cut into pannels.

The number of the layers, reckoning from the pith to the bark, on one side of a transverse section of the butt or trunk, indicates the age of the tree exactly; for the layers never run into each other, nor do they increase or diminish after they are once imposed.

After the tree has passed its mature age, it at last begins to decay; the first imposed layers next the pith fail first; and this decay at the heart extends outwardly, till the trunk becomes a hollow cylinder, when the whole is laid prostrate by the wind. This happens sooner or later, according to the durability of the timber. Some kinds, from the light porous character of the wood, and aqueous quality of the sap, perish in a few years; others, from the density of the grain, and preservative quality of its concreted juices, resist decay for many years.

The Bark. The seedling rises from the ground with its coat of bark, consisting of a layer of green parenchymous matter, covered by a thin cuticle. This ever remains on the exterior of the greater number of trees, and is distended as the internal growth increases. Some few trees and shrubs, as the plane, arbutus andrachne, and others, discharge their bark every third or fourth year, but on the greater number the outer bark remains, and is either rent into longitudinal irregular furrows, or stretched horizontally. At the end of the second year, the second layer of bark within the first becomes visible, and takes the name of *liber,* a new layer of liber being formed within the former in every year during the life of the tree. The diameter of the tree is thus increased by a new layer of alburnum, or white wood, and a new layer of liber; of course they are always equal in number to each other. The liber, however, of many trees, is so thin, and of so open a fabric, that the layers cannot, without maceration, be easily separated from each other; but others, as those of the lime-tree, are so entire and tenacious, that they are easily separable, and woven into Russia mats.

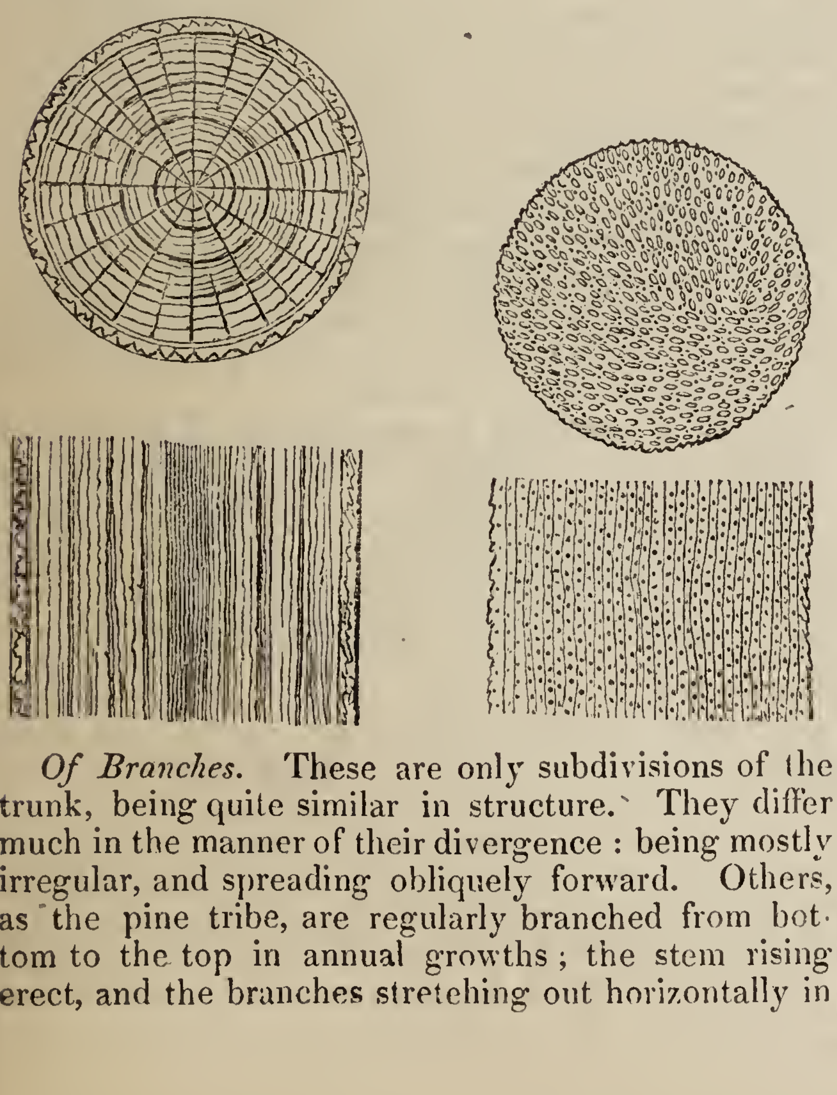
The new layers of wood and bark are the principal channels for the motions of the sap, it being always more copious in those members than in any other. Whatever the qualities of the sap of any tree may be, we generally find them more powerful and in greater quantity in the bark than in the wood; hence the many purposes to which bark is employed in medicine and in the arts.

The stems or trunks of monocotyledonous plants are very differently formed. Instead of additional layers of new matter being deposited on the outside (*Exogenæ*), the new accretion is formed, and proceeds from within (*Endogenæ*). This manner of growth is exemplified in the palms and other plants belonging to the same class, but the most familiar instance is that of the common asparagus. In this plant it will be observed (if we consider one division of it) that it has a system of thick fleshy roots, fringed with fibres, proceeding from the collet, or crown. From the centre of the latter the stem takes its rise, and is almost as large on its first appearance above ground as it is ever afterwards. Its development is evidently an elongation of its previously existing organisation, and surely not consolidated by any fibrous processes, which, during growth, descend from the branched head.

The stems of all the other orders of monocotyledoneæ are similar in their development. Whether we examine the peduncles of bulbs, the stems of the irideæ and musaceæ, or the culms of the gramineæ, we find they all gain elevation by an elongating process, and by the simple distension and subdivision of the cellular and vascular apparatus, without addition of any new matter save the incremental elements which they extract from the earth and atmosphere. Here it may be necessary to premise, that in considering or investigating vegetable structure in general, we should always distinguish the mere distension of the cellular and vascular fabric of plants from their elements. The former are rudimental, the latter accessory; the first pre-exist before enlargement, the last are imbibed during, and to assist enlargement.

The development of other monocotyledonous plants may be noticed here. There are two very remarkable constitutional differences; in some the fructification is terminal, that is, placed on the point of a central stem; but in the greater number the fructification is lateral, that is, issuing from the axils of the leaves. Of the first description is the common American aloe, which is constituted of roots, a certain number of leaves seated on the collet, and which are developed *seriatim* from the circumference to the centre, the last involving the fructification, which, when produced, and the seeds ripe, the whole dies. The second description comprises most of the palms; the evolution of these begins by the expansion of the first exterior leaf, which is usually the least of all that follows; a second succeeds, with all the rest in train, until all are expanded, or so long as the plant retains vigour to bring them forth. The petioles, or foot-stalks of the leaves or fronds, as they are called, remain attached to the collet, and in time acquire a woody consistence, and aggregately compose what afterwards becomes the stem. This is conspicuously the case in the genus *Zamia*, and in all the dwarf palms, which, though they continue to evolve fronds and flowers, never show any great elongation of their axis. In the case of the lofty-growing palms, the first evolution of their radical leaves is similar to the dwarfs; but with the consecutive development of their leaves, an elongation of the axis commences, and continues rising to the height of sixty feet or more. This altitude is gained slowly, the exterior of the stem being formed by the persisting bases of the leaves, and being connected with each other within, and with the collet, whence they all spring, form the stem. Thus it appears that the fronds are only expanded portions of the stem, the whole being one uniform body of longitudinal fibres, embedded in coarse cellular matter, hardening, and becoming more compact by age. On a cross section, there appear no consecutive layers or divisions of the structure to indicate periodical additions, like those of exogenous stems, and may be described as the *common* petiole of the foliage and flowers.

The annexed figures represent transverse and perpendicular sections of dicotyledonous and monocotyledonous stems.



Of Branches. These are only subdivisions of the trunk, being quite similar in structure. They differ much in the manner of their divergence: being mostly irregular, and spreading obliquely forward. Others, as the pine tribe, are regularly branched from bottom to the top in annual growths; the stem rising erect, and the branches stretching out horizontally in every direction; when branches are so disposed, they are said to be *verticillate.* In some cases the branching is regularly alternate; in others produced in opposite pairs, alternately crossing, in which position they are said to be *decussated.* The branching of trees constitutes their chief beauty: the lower and lateral ones are mostly inclined to droop at the extremities, and which in many sorts is most graceful. The pendent spray of the weeping willow, birch, and ash trees, are universally admired, being much more beautiful than the stiff and formal forms of the larch and Lombardy poplar.

The Leaves. The foliar expansions of plants are of several descriptions. The first to be noticed, are the scales or winter coverings of the buds, hence called *hybernacula.* They consist of dry membranous scales seated at the base of the bud, over which they are imbricated, and mostly deciduous when the bud bursts. They are in some instances covered with thick down; in others with gum, as the balsam poplar, or with resin, as in most of the order *Coniferæ.* Without such a provision as this, all the buds of trees and shrubs in the regions of frost would be destroyed; but such is the protection afforded by *hybernacula,* that they can bear thirty degrees of frost without injury.

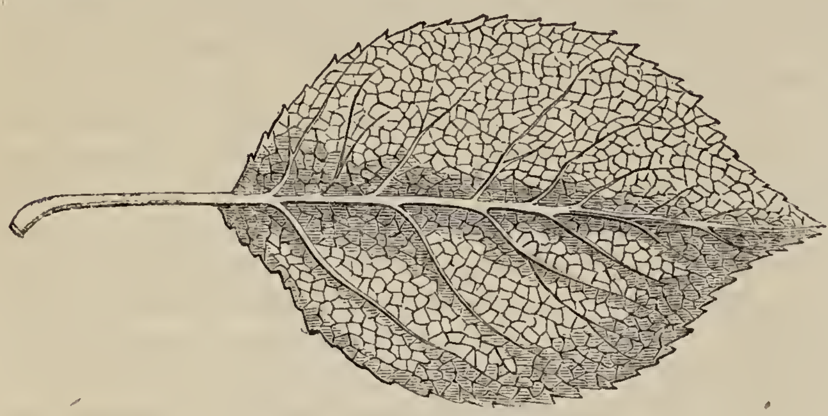
The *Stipulæ* are the next leaf-like expansion to be noticed: they are sometimes single, but very frequently double, and situate at the base of the petiole, or leaf-stalk, one on each side, shown beneath.

Stipulæ.

Sometimes they are united to the petiole, or changed into prickles, as in the berberry. In some of the grasses the stipulæ is single, investing the culm a little above the limb of the leaf, whence they are said to be intrafoliaceous; and when seated on the outside of the petiole, they are said to be extrafoliaceous. In some plants the stipulæ embrace the stem like a sheath; in others they invest the top of the shoot, as in the fig tree. Stipulæ generally fall with the leaves.

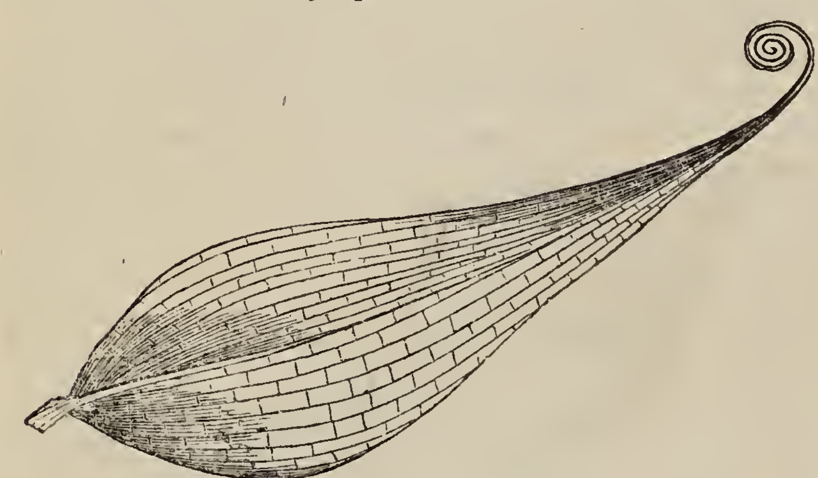
The proper leaves are the grand ornaments of plants; from their numbers, position, and delicacy of organisation, they are destined to effect some important office in the economy of the plant. They are, however, only temporary organs, being articulated with the surface of the bark, and always seated upon, or near the buds. Those of deciduous trees or shrubs drop or wither as soon as the summer growth is over. Some of both of those descriptions retain their leaves to the second or third year, hence they are called evergreens; and some of the pines and firs retain them for many years.

Leaves are generally furnished with a foot-stalk (*petiole*), though sometimes this member is wanting, in which case they are said to be sitting (*sessile*). The footstalk is either short or very long; somewhat grooved on the upper side, and convex below; it is produced into the web or disk of the leaf, where it forms the mid-rib (*costa*), whence branches like veins are sent off, traversing the whole disk. This disposition, and lateral branching of the mid-rib only, obtains in dicotyledonous plants: the leaves of the



Dicotyledonous leaf.

class *Monocotyledoneæ* have the footstalk more equally divided at the point where it enters the disk, and thence projected towards the point of the leaf in nearly parallel lines, fig. 14. The



Monocotyledonous leaf.

web of the leaf is filled up between the veins by cellular tissue, having a thin porous cuticle both above and below. The structure of the upper and under surfaces of the leaves are not alike; one is supposed to be furnished with excretory, the other with incretory organs. Water plants, whose leaves are constantly submersed, have no cuticle.

Leaves are either simple, as in the myrtle, or compound, as in the mountain ash. Compound leaves are distinguished into pinnate, bipinnate, tripinnate, ternate, biternate, triternate, and digitate.

A pinnate leaf is said to be *equal*, when the leaflets are opposite to each other on the footstalks; *alternate*, when placed one above another; *terminal*, when the primary footstalk has a single leaflet at its apex; *cirrhose*, when it is terminated by a tendril; *abrupt*, when it is terminated by a pair of leaflets; *interrupted*, when the alternate pairs are long and short; *articulate*, when the footstalk is jointed between the pairs of leaflets; and *decurrent*, when the leaflets have a membranaceous continuation down the foot-stalks.

A bipinnate leaf is when the footstalk itself is divided, and branching out into other footstalks, each of which supports leaflets corresponding to the simply pinnate leaf in all its modifications.

A tripinnate leaf is of the same description as the above, once more decompounded. The petiole being bipinnate, supporting leaflets as in the former modes.

A ternate leaf is so called, when the footstalk supports three leaflets, as is exemplified in the wood-sorrel.

A biternate leaf is when the common footstalk supports three others, each of which supports three leaflets.

A triternate leaf is only a further decomposition of the above.

A digitate leaf is when the common petiole supports several leaflets, diverging from a common centre at its apex.

Leaves are either radical, i. e. proceeding from the crown or radical plate, or caulinar, i. e. borne on the stem; and either sessile or petiolate, that is, either sitting, or having footstalks. A sessile leaf is sometimes *vaginant*, that is, sheathing, as in grasses, or *amplexicaule*, stem-clasping, as in many of the umbelliferæ; or *connate*, situate opposite each other, and united at the base, circumscribing the stem, as in the leaves of the honeysuckle. In some cases connate leaves form cups, which hold rain, probably for the supply of the plant, or they are *decurrent*, running stem, as sow-thistle.

The leaves are the principal organs of respiration, and contribute to the growth by their powers of absorption. Gaseous qualities are emitted as well as inhaled by them; and that they allow the escape of aqueous fluids is well known. As they aggregately present an extensive surface to light and all atmospheric influences, their action in the development of the plant is indispensable. As such, they are with great propriety called "the lungs" of vegetables. They are mainly instrumental in producing a constant flow of sap upwards, in consequence of their perspiring functions. In proportion to the quantity of foliage, in like proportion is the need of, and consumption of water. Indeed it is not too much to assume, that hydraulic action is their chief office: the amplification of the system could not take place without such agency, to excite intestine motion of the fluids, and thereby assist the enlargement of the various membranes. The health and vigour of every plant depends very much on the number and amplitude of the leaves. Defoliation, either naturally, or by art or accident, instantly arrests the growth, and the failure or diminished expansion of foliage, is a certain sign of debility. There is a numerous description of plants called succulents, which have few or no leaves, as the torch and melon thistles; but their stems are much dilated, presenting a large superficies of parenchymous exterior to the air and light; or they are profusely covered with spines, which no doubt, conjointly, do the office of leaves.

Green is the most general colour of leaves, but some are red, or purple, or yellow; some appear nearly white, in consequence of being clothed with short woolly or silky hair. They differ much in substance and structure; some are immensely thick and fleshy, as those of the genus aloe, others remarkably thin, as those of the beech. The texture of the surface is also very dissimilar; some are rough, prickly, and wrinkled, others smooth and glossy. In some leaves, the middle rib and its ramifications or veins are flat, on others remarkably prominent below.

The figure of leaves are extremely various, and sometimes constitutionally variable on the same plant, as in the genus acacia; in which the bipinnate leaves of some of the species are changed into a single oblong leaflet called *Phyllodium*, which is also altered in position, one of the edges being for the most part turned to the sky.

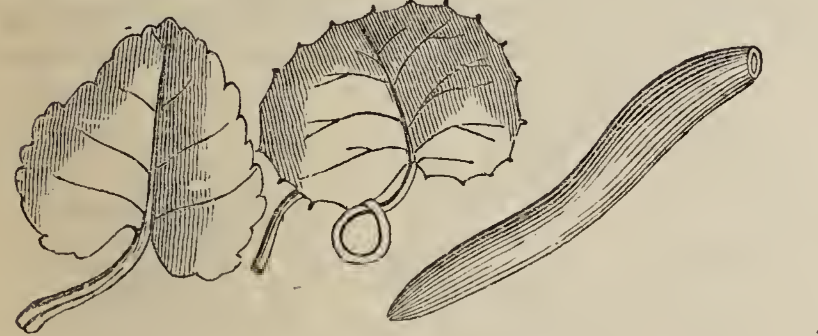
The form, size, texture, &c. of leaves, furnish many specific distinctions. Some are named from their resemblance to parts of animal bodies. Others from their resembling instruments of war, of music, or of well known machines. Others again are named from geometrical figures, or from the heavenly bodies. They have also names to signify to what part of the plant they are attached; as whether *radical*, springing directly from the root; *caulinar*, growing on the stem; *rameum*, borne on the branches; *axillary* proceeding from the angle between the stem and a branch: the same term is used in describing flowers, peduncles, or stipules arising from the same place. Leaves are also said to be *floral* when placed near the flower, and *seminal* if they are the first which spring from the seed.

The terms which most commonly occur in descriptive botany are as follow:—

Cordate, a heart-shaped leaf or leaflet, fig. *a*, as exemplified in the birthwort and many other plants.

Reniform or kidney-shaped, as in ground ivy, fig. *b*. This term is also frequently applied to seeds.

Linguiform, that is tongue-shaped. This description of leaf is frequently seen among what are called succulent plants, as in the families of aloes and mesembryanthemums. It is "linear and fleshy, blunt at the end, convex beneath, and having usually a cartilaginous border," fig. *c*.



a *b* *c*

Auriculate, ear-shaped, or rather having appendages like ears, or lobes at the base, fig. *d*.

Palmated, a hand-shaped leaf; example, the common passion-flower, fig. *f*.

Digitate, a fingered leaf. This is distinguished from the palmated leaf, in the leaflets representing fingers, being all attached to the point of the petiole or footstalk; whereas the other has a broad space like a palm of a hand, whence the divisions proceed; the digitate leaf is exemplified in those of the horse-chestnut, fig. *g*.

g *f* *d*

Pedate, that is like a foot of a bird; a leaf divided into several slender divisions, fig. *h*.

Ovate, an egg-shaped leaf, in which the base is somewhat broader than the point, fig. *i*.

Oval, an oval-shaped leaf; in which both ends are equal, fig. *j*.

Elliptical, a leaf like an oval, only more elongated,

j *i* *h*

fig. *k*. It often happens in leaves of some of the preceding forms, that the broadest part is most distant from the petiole; in which case they are said to be *obovate, obcordate*, &c., that is, inversely heart, or egg-shaped.

Sagittate, arrow-head shaped leaf. This occurs frequently in the arum family, and many other kinds of plants, fig. *l*.

Hastate, are such leaves as are shaped like the head of a halbert or battle-axe. This differs but little from the auriculate leaf, fig. *d*.

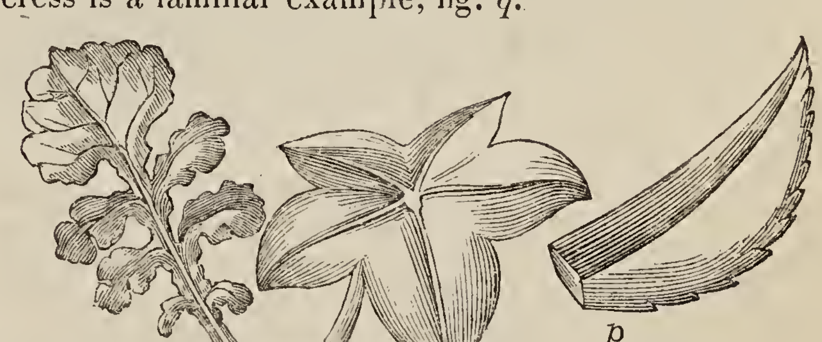
Lanceolate, an oblong leaf which tapers to each end, this is exemplified in the common ribwort, or ribbed leaved plantain, fig. *n*.

Ensiform, or sword-shaped leaves, are such as those of the iris, fig. *o*.

o *n* *l* *k*

Acinaciform, are leaves resembling the Persian cimiter: one edge being convex and sharp, the other nearly straight and thick. Example, *mesembryanthemum acinaciforme*, fig. *p*.

Peltate, a target-shaped leaf; in such the footstalk instead of being inserted into the margin of the leaf, is fixed at or near the centre of the under surface. The ivy-leaved geranium and nasturtium, or Indian cress is a familiar example, fig. *q*.



p

r *q*

Lyrate, leaves shaped like the musical instrument, the lyre. It is somewhat like a *pinnatifid* leaf, only the terminal segment is very large and rounded, fig. *r*.

Dolabriform, a hatchet-shaped leaf. This very peculiarly formed leaf only occurs among the mesembryanthemums. It is thick and succulent; narrow where it is fixed to the stem, but spread out and rounded at the point like the edge of an axe, fig. *s*.

Deltoid, a trowel-shaped or three-sided leaf, resembling the Greek letter delta, fig. *u*.

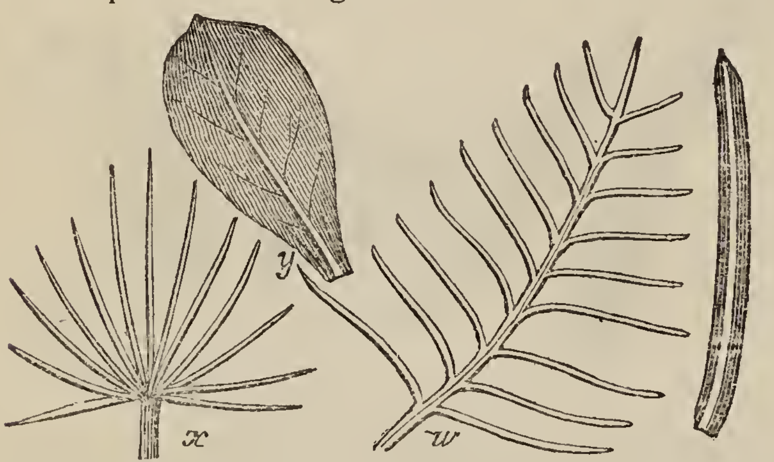
Subulate, awl-shaped leaf; it tapers from the base to the point, and is so called whether it be flattened, or hollow; if the latter, it is said to be *tubular*, fig. *v*.

v *u*

Acerose, all leaves which bear a resemblance to those of the yew or fir-tree, are said to be acerose. They are linear, awl-shaped, rigid, and evergreen, and either sitting singly and regularly along the branches, or placed in bundles of several together, fig. *t*.

Pectinate, is a sort of pinnate leaf, only the pinnæ are so narrow that they resemble the teeth of a comb, fig. *w*.

Flabelliform, is a fan-shaped leaf, that is the disk is split into spokes or radii. The term is mostly used in describing the fronds or leaves of palms. One is represented at fig. *x*.



t

Spatulate, a form of leaf resembling the instrument used by apothecaries for spreading salve; that is a flat knife, very broad and rounded at the point, fig. *y*.

Cuneiform, or, wedge-shaped; this is very much like what is called deltoid.

Carinate, keel-shaped; said of leaves whose centre of the back is prominent like the keel of a ship.

Lunated, are such leaves as resemble a crescent or new moon. In some plants the horns point toward the stem, in others from it. In either case, they are said to be lunated.

Stellated, is a star-like leaf, or rather leaves placed in star-like order. This term is however seldom used; *verticillate* is the term applied to such leaves as stand round the stem like rays pointing every way, as those of the cleavers and woodroffe, fig. 1.

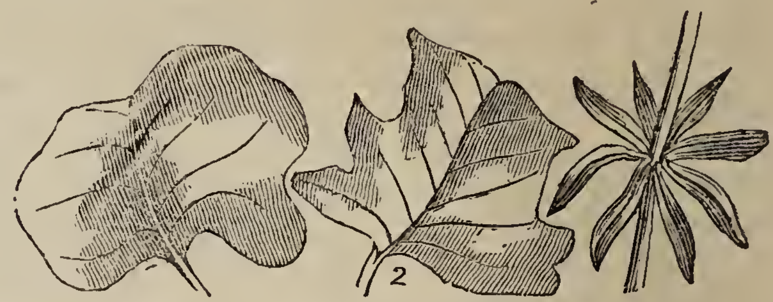
Cucullate, leaves are called cucullate, if they take the shape of a cowl or hood reversed; that is, wide at top and narrowing to a point at bottom.

Truncated, is spoken of a leaf which appears as if its apex were cut off, as those of the common saddle-leaved tulip tree, fig. 2.

Retuse, leaves are said to be retuse when they terminate bluntly, or have a slight sinuosity instead of an acute point, as fig. 3.

Unequal, is when the two sides of a leaf do not correspond in size, as may be observed in those of the elm.

Besides the foregoing, there are several other forms of simple leaves introduced into specific descriptions of plants, such as *bifid, trifid, quadrifid*, that is two, three, four-cleft, and so on. There are also *orbicular, round*, and *cylindrical* leaves, with modifications of these into *subrotund*, roundish; *rhomboid*, diamond-shaped; *linear*, all of the same breadth; *integrum*, entire, or undivided; *lobed, parted, laciniated* or torn, &c.

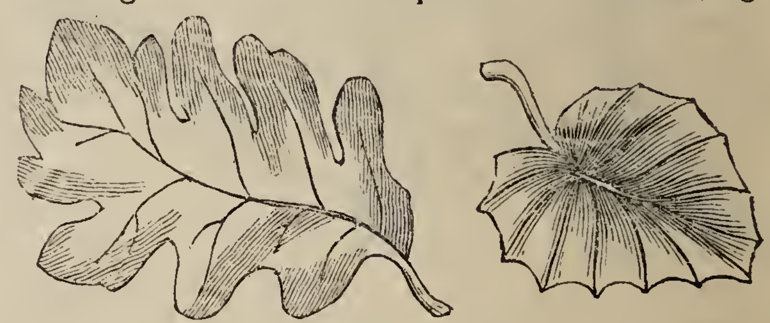


3 1

Hitherto the general outline or form only of the leaves have been noticed; we have next to advert to the terms used by botanists in describing the margins of leaves, and which are applicable to all leaves whether simple or compound.

Integerrimum, most entire; this term is only used in allusion to the margin, not to the leaf itself. A leaf may have many sinuosities, as the passion-flower for instance, and yet have an entire margin like a hem all round; and it is in this sense that the term only integerrimum is used.

Repand, bowed or bent back, in consequence of the margin being confined by internal segments of circles preventing the horizontal expansion of the leaf, fig. 1.



2 1

Sinuated. Leaves having deep rounded indentations like those of the oak, fig. 2.

Undulated. A leaf receives that character when its margin is waved up and down vertically like those of the holly, but without prickles, fig. 3.

Crispum. That is having the margin curled or contorted like some varieties of cabbage, fig. 4.

4 3

Plaited, "folded like a fan, the plaits being acute." This beautiful conformation is exemplified in the common meadow plant, called ladies' mantle, fig. 5.

Eroed. That is when the margin is so irregular that it appears as if gnawed by an insect.

Cartilaginous. This is spoken of some leaves whose margin is composed of a harder substance than the rest of the leaf.

Glandular. That is when the edge of the leaf is studded with little glands or processes.

Dentated. When the margin is cut into teeth, or projections shaped like the canine teeth of animals, fig. 6.

Doubly-dentate is when the teeth are each indented and all pointing upwards, fig. 7.

7 5

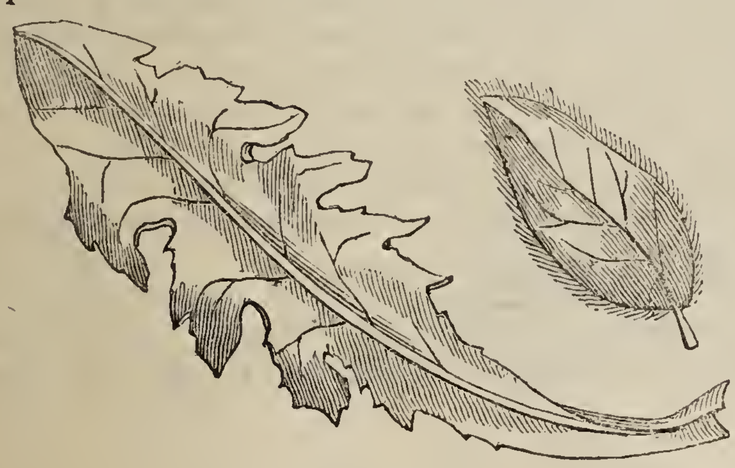
Serrated. That is when the margin is cut like a saw, fig. 8. When the projections are small and fine, the margin is said to be serrulate.

Crenate is when the projections are blunt and point neither upwards or downwards, fig. 9. The margin so described may be either obtusely crenate, acutely crenate, or doubly crenate.

Armed. This is said of leaves whose margins are defended with prickles as the common holly, the pine apple, and many other plants, fig. 12.

Ciliated, from cilium, an eye-lash. This term applies to the margin of the leaf, and means that it is fringed with hairs, fig. 10, example *Protea ciliatum.*

Runcinate. Leaves are called runcinate when the margin is cut into deep gashes like the teeth of a pit saw, the points of the teeth pointing backwards, exemplified in the common dandelion, fig. 11.



11 10

TERMS DESCRIPTIVE OF THE SURFACE.

Wrinkled. The leaves of sage, and all others similar, are said to be *rugose* or wrinkled, caused by the web of the leaf between the veins being more dilated than the veins themselves.

Blistered. Having a surface like the preceding only extremely so.

Lacunosum. That is, pitted on the upper surface, caused by the depression of the web of the leaf between the more rigid veins.

Punctated. The surface covered with dots, usually "arising from glands imbedded in the surface of the leaf."

Coloured. Leaves are said to be coloured when they are of any other colour but green.

Ribbed. A leaf is said to be ribbed when the divisions of the mid-rib or costa run in direct and parallel lines from the centre to the margin.

Nerved. When the nerves run in lines from the base to the point.

Veined. When the divisions of the costa are numerous, and form a net-work over the web of the leaf.

Armed. When the disk is partially covered with prickles, as the thistle, rose, and some varieties of holly.

OF THE SITUATION OF LEAVES.

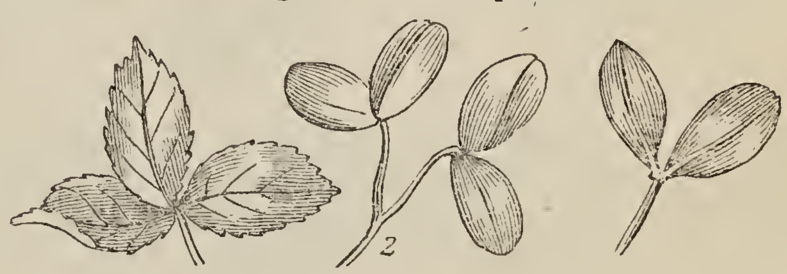
If a leaf be seated upon, and clings closely to the stem, it is said to be *adpressed.* If leaves rise from the stem one above another on opposite or on nearly opposite sides, they are described as *alternate.* If their bases surround the stem, they are said to be *amplexicaule.* If so thickly placed as to hide the stem they are said to be *conferted.* If two opposite leaves are united by their bases, so that the stem appears to run through them, they are said to be *connate,* that is growing together. If the leaves of water plants grow under the surface, they are described as *submersed;* if above the surface, they are *emersed;* and if they float they are said to be *natant.*

COMPOUND LEAVES.

Some of these have been already described, and two of them (the palmate and digitate) have been already figured; we now proceed to name and give figures of those of most common occurrence.

A compound leaf differs from a simple one in this, that whereas the latter stands singly on the petal or footstalk, the former stand in pairs, threes, &c.

If two leaflets are borne on the footstalk, they are said to be *binate,* fig. 1. If the petiole divide at the



3 1

summit, and each division end in two leaflets, it is called *bigeminate,* or a twice-twinned leaf, fig. 2. If one petiole bears three leaflets attached to the end, it is called a *ternate* leaf, example the wood-sorrel, or shamrock, fig. 3. If the petiole be divided, and on the end of each division three leaflets be attached, this disposition is called *biternate,* fig. 4. Suppose

5 4

again that the petiole has three branches, each bearing three times three leaflets, then we have a *triternate* compound leaf, fig. 5.

When a petiole is undivided, but bears on each side any number of leaflets, either placed alternately or in opposite pairs, it is said to be a *pinnated* or winged leaf, fig. 6. In describing such a style of foliage, it is usual to particularise the number of *pinnæ* by the terms *trijugous*, *quadrijugous*, and so on.

Sometimes the pairs of leaflets are equal, in which case the leaf ends abruptly, hence called *abruptè pinnatum*, fig. 7. But if the petiole bears, besides the side ones, a single leaflet at the end, then it is called *pinnated with an odd one*, fig. 8. If instead of this odd leaflet at the end, the extreme point of the petiole be resolved into a tendril, as is the case with the pea, then it is called *pinnatum cirrhosum*, fig. 6.


7

8 6

Another form of winged leavés is called *interruptè pinnatum.* This is when between every larger pair of leaflets a smaller pair is placed, fig. 11. A compound leaf which has the leaflets connected by a leafy expansion running along the edges of the petiole, is called *decursively pinnate.* If the petiole be articu-


11 10

lated at the points where the pinnæ are fixed, the whole is called *jointedly pinnate*, fig. 10. When a petiole is divided and bears pinnæ on each division, it is called a conjugately pinnate leaf, fig. 12.


13 12

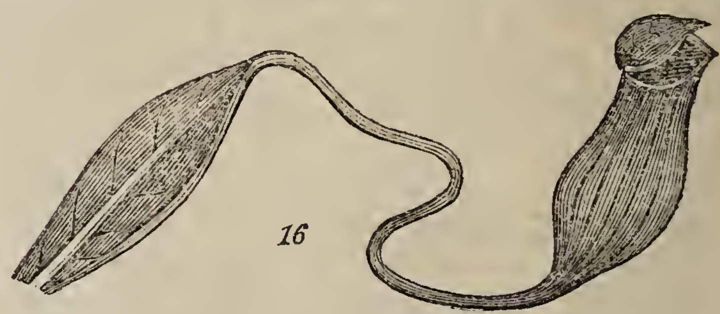
In the digitate leaf each leaflet is entire; and there are digitate leaves where the leaflets are pinnated, hence called *digitatum pinnatum*, being both fingered and winged, fig. 13.

Bipinnate and tripinnate leaves may be easily understood by a glance at the cuts on which they are represented, figs. 14 and 15.

There are some plants whose leaves are of so remarkable a shape, that they do not belong to any of the foregoing characters. Of these we may notice the pitcher plant (*Nepenthes distillatoria*). The proper leaves are lanceolate, and beyond the apex of each the mid-rib protrudes like a tendril to the length of several inches. The extremity of this tendril becomes inflated into a bladder-like vessel, two or three inches in length, and nearly one in diameter; the outer extremity of the bladder is open, but supplied


15 14

with a hinged lid which shuts close upon it, like the lid of a flagon, fig. 16. The vessel is always more


16

or less filled with water, which appears to be distilled from the plant itself, as the lid prevents rain falling directly into it. No rational account has yet been given of the use of this appended cistern, to the plant itself, or to any other creature near it.

There is another plant (*Cephalotus*), which is furnished with similar, but far more elegant appendages of the like kind. Both are marsh plants, and therefore it is the more remarkable that they should have reservoirs for the retention of the very element in which they stand.

The *Dionæa muscipula*, or vegetable fly-trap, may be mentioned as having leaves of very odd conformation. At the point of each leaf two smaller leaflets are placed opposite each other, on hinges at bottom. These open and shut against each other, and their upper edges are furnished with bristles, which fit in between each other crosswise when shut. In fine weather they are generally wide open; and should a food-seeking fly creep into the furrow between the leaflets, these suddenly collapse and crush the intruder to death.

Of Bracte. This is a foliar appendage which accompanies the flower, but different from both the proper leaves and the members of the flower in shape


Bracte of the lime and helleborus.

and texture, and frequently in colour. Though most commonly seated below the florets, as in *Justitia*, it is above them in *Eucomis.* In some instances it resembles the proper leaves, as in *Mespilus;* but is often of a membranous texture as in *Helleborus.* In some of the *Orchideæ* the leaves are gradually resolved into bracte, so that it is difficult to decide where the leaves terminate, and the bracte commence. The chaff of grasses are bracte.

Of Involucre. This is allied to bracte, but as it occurs conspicuously on umbelliferous plants, it is deemed proper on this account to distinguish it by this name. The involucre consists of one or more leafy expansions, differing in shape from the proper leaves of the plant, situate at the base of an umbel.

Involucre of a phlox and Chinese primrose.

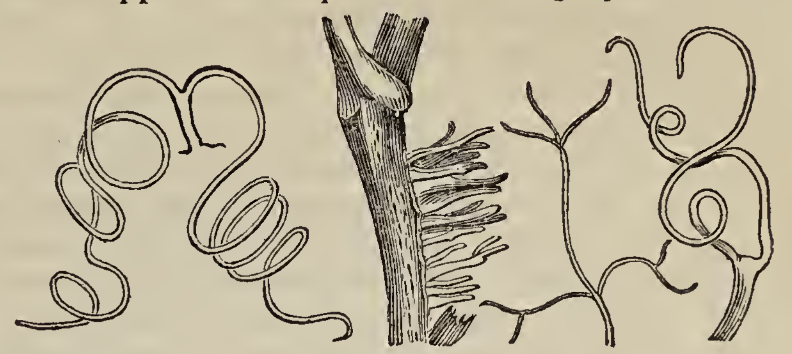
When at the base of a compound umbel it is called the general involucre, and when at the base of the partial umbel the involucellum. The bracte of the anemone has been supposed to be involucre, but this is not generally allowed.

Of the Spathe. This member is the membranous covering which involves the flowers of the snowdrop, onion, arum, and palms before their expansion. By some botanists it is called bracte, by others involucre, but as it is not decided which it really is, it is as well to call it by the conventional term most generally known.

Spathe.

Arum. Narcissus.

Of the Tendril (*Cirrhus*). The tendrils are those convolving strings or claspers by which plants are occasionally supported. They are produced on different parts of flexible stems, and attach themselves to other bodies for the support of the plant; on the grape-vine they



are inserted from the young shoots opposite the leaves, fig. 1; in the pea the points of the footstalk of the leaves are resolved into compound tendrils, fig. 2; the superb lily bears them on the points of the leaves, fig. 14; and on the ivy they are short processes issuing from the bark, fig. 4.

Of the Armature. Plants are furnished with defensive appendages called spines, prickles and stings.

Spines (*Spinæ*) are woody processes issuing from the stem, and appearing to be abortive shoots, as those of the white thorn and wild crab apple; from the points of the leaves, as butchers'-broom; from the calyx, as the thistle; from the seed-vessel, as the thorn apple; and from the seed, as spinach.

Prickles (*Aculeus*) are situate on the bark, and appear to be articulated therewith, as in the rose and gooseberry. Sometimes they take the place of other members of the plant, as instead of stipulæ in the berberry, and bastard acacia. In the genus *Mammalaria* and other succulent plants, prickles appear to do the office of leaves.

Stings (*Stimuli*) are a smaller kind of prickles, but with this difference, they emit a poisonous juice into the punctures made by them, causing painful irritation and inflammation. Example, the common nettle.

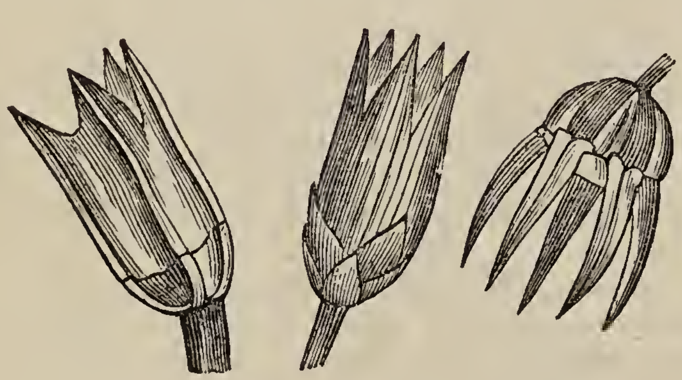
Glands are small protuberances seated on various parts of plants. They are either secretory or excretory organs. Fibrous roots are observed to issue from those situate on the bark of the common laurel, if the branch be layered in the ground. Professor de Candolle remarks that these bear the same relation to the roots that buds bear to young branches. They are very conspicuous on the petioles of the peach, and passion flower. Glands are described by botanists under various names, as miliary, bladder, scaly, lenticular, cup-shaped, and utricular, the latter being very visible on the young shoots of the vine, and on several species of fig-marigold, appearing like globes of crystal.

Pubescence. The exterior cuticle of plants is either perfectly smooth and naked, or covered with hairs; in some cases, soft and fine as silk, as the silver tree (*Protea argentea*); or rough and harsh (*asper*) when the whole plant is covered with short rigid bristles, as borage. Botanists employ many different terms in describing this clothing of plants, viz., *hirsutus*, hairiness; *villosus*, villous; *tomentosus*, downy; *glochidatus*, barbed or bearded; *sericeus*, silky; *arachnoid*, cobweb-like; *rostella*, hooked, &c.

Scales. The cuticle of some plants is profusely covered with scale-like processes, giving a greyish hue to the surface. They are microscopic objects, and may be met with on the leaves of the pine-apple; plants bearing them are said to be leprous (*lepidotus*). Another cuticular excrescence of a scale-like character is borne on the young shoots and backs of the leaves of ferns, these are called *ramenta*.

Of the Flower and Fructification. The members of the flower are the calyx, corolla, stamens, disk, nectarium, pistillum, and receptacle.

The Calyx. This is the external investment of the flower, and in which it sits as in a cup. By the early botanists it was said to be the termination of the outer bark; but this is no longer a proper distinction; because in composite flowers, the parts called *pappus* are deemed calyces, although they occupy the centre of the disk. The common calyx is sometimes entire, in which state in some instances it is thrown off by the growth of the corolla and stamens. More frequently, however, it is divided into segments (*sepals*), which separate from each other more or less from its outer edge downwards. It is most commonly green, but in some flowers it is highly coloured, as in the marvel of Peru, mezereon, and fuchsia. In many cases it is quickly deciduous, in others it remains till after the fruit or seeds are ripe. In size the calyx varies from a mere ring to a considerable tubular expansion. It is said to be inferior if situate below the ovarium, and superior if attached to its side, or seated on its apex, as exemplified in the apple and pear. In some cases it is double, or formed of many scales, as in the camellia; and in syngenesious flowers, as the artichoke, that part which used to be called a scaly calyx is now called *Anthodium.* In some flowers, as the tulip, it is said to be wanting; but this is not admitted by the first authorities. In the flower just named, the three outer petals are to be considered calyx, and the three inner ones corolla. And it is laid down as a rule that, where there is a plurality of floral investments, the outer one must always be considered as the calyx. This organ is usually deemed the external defence of the more delicate members of the flower; but besides this its most ostensible office, it is destined to perform others, and to be transformed into the most valuable products of the plants. In the order *Gymnospermia*, of the class *Didynamia*, the calyx becomes the seed-vessel; and in the genus *Pyrus*, the incrassated bottom of the calyx becomes the fruit. The following figures represent several of the most common forms of the calyx.



The Corolla is the delicate and usually high-coloured row of leaves (petals) which stand immediately within the calyx. If the petals are distinct from each other they are said to be *polypetalous*, if united into a tube the corolla is said to be of one petal (*monopetalous*). When thus united, the tube is of more or less length and the lip more or less open; if regularly divided, and the divisions diverge regularly, it is said to be wheel-shaped (*rotate*); if so flatly as to resemble a plate, they are called salver-shaped (*hypocratiform*); or funnel-shaped (*infundibuliform*); or bell-shaped (*campanulate*); or lipped (*labiate*). If the exterior lips or edges of the corolla be unequally divided, and if the upper division be arched, that is bending over, it is called the helmet (*galea*); if the lips be very wide apart, the corolla is said to be gaping (*ringent*); if the upper and lower divisions meet and are pressed together, it is said to be like a mask (*personate*). The central opening of such a corolla is called the throat (*faux*), and the petals which form it when separately considered are said to consist of two parts, viz., the claw (*unguis*), by which it is fixed to the receptacle, and the lip or border (*limbus*) which is expanded in the air.

According to the order in which a many-petalled corolla is disposed, botanists have designated them by different appellations, viz., like a rose (*rosaceous*); like a lily (*liliaceous*); like a pink (*caryophillaceous*). Some are disposed like a cross, hence called *cruciform;* others resemble a butterfly (*papilionaceous*); and the different members of these last named flowers receive characteristic names, viz., of five petals, the upper one is called the standard (*vexillum*); the two side ones are the wings (*alæ*); and the two lower ones being united form the keel (*carinæ*), fig. 22.

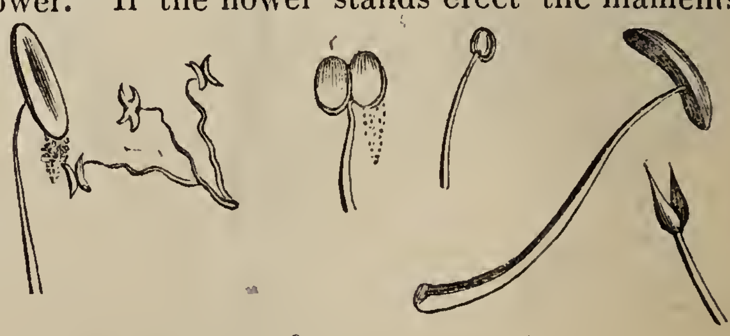
The corolla of a floret is called *corollula;* if the corolla be wanting, the flower is said to be *apetalous;* and if a part of the corolla be lengthened behind into a hollow tube, it is called a spur (*calcar*). Example the larkspur.

From the great variety of forms in which the corolla is exhibited, the terms equal and unequal, regular and irregular, are properly applied; and though in the generality of plants it forms but one rank of petals within the calyx, yet in some there are several, as in the flowers of the water-lily.

The corolla is sometimes furnished with certain appendages attached to the throat, or to the interior base of the petals. These are commonly called *nectarium*, because they hold, and are supposed to secrete honey. They are sometimes in the shape of a rim or cup encircling the throat, as in the auricula; like erect scales at the bottom of the claw, as in the ranunculus; or extended like a trumpet, so conspicuously beautiful, as in some species of narcissus. In the passion-flower it is divided into numerous parti-coloured filiform rays like a rich fringe. When the corolla is prolonged into a spur behind, it is also called the nectary.

The annexed figures represent the most common forms of flowers. See plate.

The Stamens. These are situate within the corolla and are the male parts of the flower, consisting of three distinct members, viz. the filament, *a*, the anther on its summit, and the pollen or dust discharged from the anther *c*. In some plants the filament is wanting: but the anther and pollen are essential. The filaments when present serve to place the anthers above or on a level with the female organ, or stigma of the flower, and are of different lengths, and assume different positions, according to the position of the flower. If the flower stands erect the filaments are



as long, or longer than the style, but if the flower nods, or hangs, they are usually shorter. The filaments either stand distinctly separate from each other or are united by a membrane at their bases, in which case they are called a brotherhood (*adelphia*); if in one united rank they are said to be one brotherhood *monadelphous*; if in two, three, or many ranks one within another, the flower is called *diadelphous*, *triadelphous*, or *polyadelphous*. If two out of four stamens be shorter than the other two, the flower is said to be *didynamous;* if two out of six are longer, the flower is *tetradynamous*.

In some flowers, as swallow-wort, the filaments converge towards the centre, and there unite and form a solid body called *columna*; in which are locaments for the anthers.

The anther is composed, in most instances, of two cells, containing pollen, and generally fixed to the apex of the filament. If attached by their base, they are said to be *innate;* if by the bark, they are *adnate;* and if by a single point near the middle, so as to swing, they are called *versatile*. When fully ripe, the cells burst longitudinally, or at the ends, to allow the escape of the pollen. Sometimes the latter is discharged by an elastic force.

The pollen is the matter which contains the fecundifying influence or principle, without the contact of which the seeds already formed in the ovarium would be abortive. The granules of the pollen are of various forms; under the microscope, they appear to be globular, oval, square, &c.; that of the sunflower is like a prickly ball, of mallow toothed, like a watch-wheel. Some have little tails (*caudicula*), and others are discharged in masses, several adhering together. The dispersion of the pollen is not only caused by the spontaneous action of the anthers, but is much facilitated by the visits of bees and other insects. The stamens are very fugitive, disappearing very shortly after the pollen is discharged.

The Disk. Between the base of the stamens and that of the seed-vessel there is a vacant space, or raised rim, of regular or irregular projections, called by modern botanists the disk, and which, by Linnæus and his followers, is called nectarium. This member of the flower is not always met with in the place

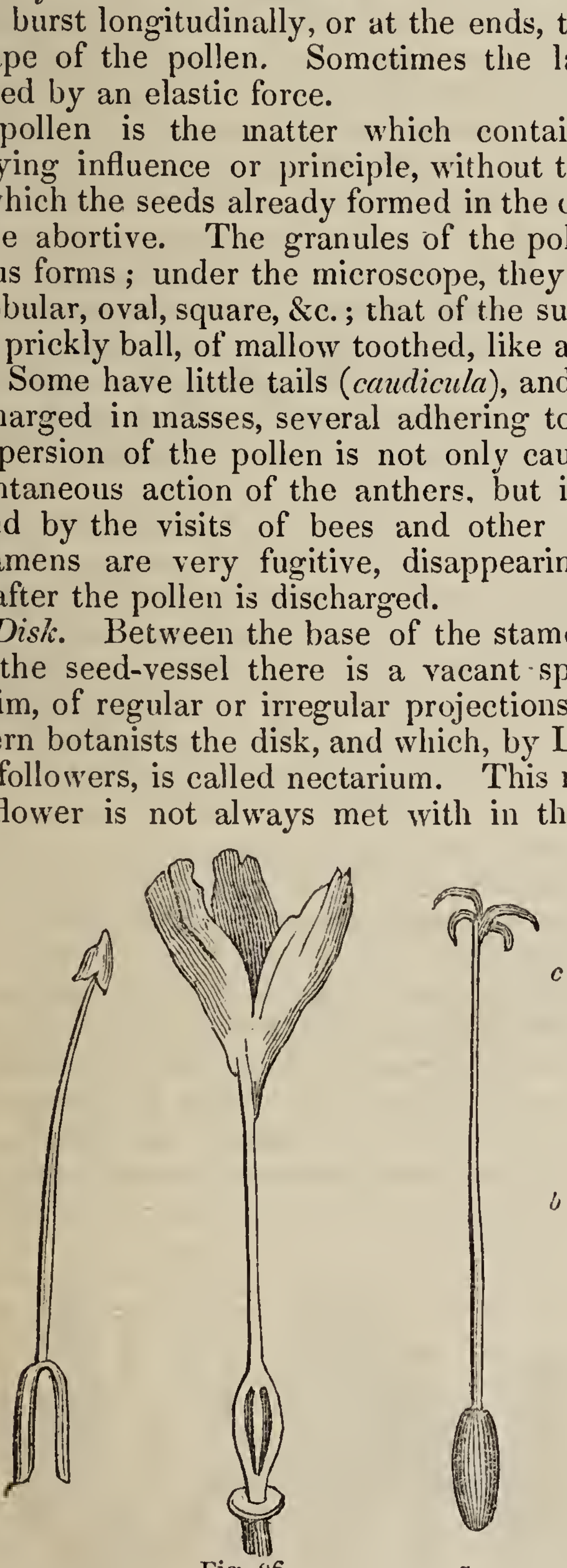


Fig. 26.

assigned to it, for it is sometimes above the germen. It also assumes so many different forms, that the most acute botanists are puzzled to find a proper name for it. Sometimes it is only a little shining cavity, or slight groove, in each of the petals; sometimes, as before observed, it is an erect scale at the bottom, or a fringe on the throat of the petals. In some cases it forms the principal member of the flower, as in the narcissus and ladies' slipper, in which two instances the forms do not at all accord with the title. But, whatever may be the station, shape, or size of the disk, it is considered in the modern schools of botany to be only imperfect, or metamorphosed portions of some of the other members of the flower.

The Pistillum. This is the principal organ of the fructification, and occupies the principal station, namely, the centre. It is the female, or reproductive part of the plant, and consists of three divisions, viz., the seed-vessel or germen *a*, the style *b*, and the stigma *c*. Fig. 26.

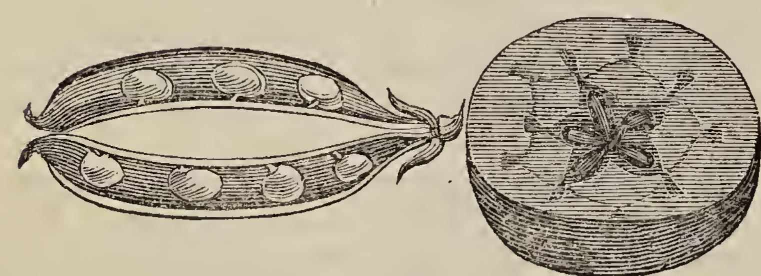
The first and third of these divisions are constant; the second is sometimes wanting.

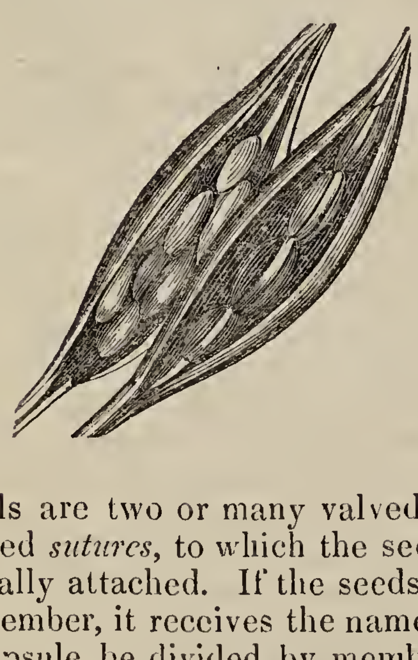
The seed-vessel has all the other members of the flower placed around or upon it. If below all the other parts, as in the pear and gooseberry, it is said to be inferior; if above the calyx, corolla, and stamens, it is said to be superior, as in the peach, orange, &c. It is one or many celled, and contains one or many seeds. In one class of plants it is formed of the calyx, the seeds lying naked in the bottom; hence such flowers are said to be gymnospermous. The seed-vessel is usually seated on the receptacle, hereafter to be described, but is sometimes elevated on a peculiar kind of stem, called *thecaphore*, either singly or several, in a kind of bunch.

As the ovarium is very differently constructed, and assumes many different shapes, it has many characters applied to it. In Linnæan botany it is called *capsula*, a little chest; *siliqua*, a pod; *silicula*, a short pod; *legumen*, also a pod; *folliculus*, a little bag; *drupa*, a pulpy valveless integument; *pomum*, an apple; *bacca*, a berry; and *strobilus*, a woody cone. Some of these names have fallen into disuse, and new ones, of more apposite meaning, substituted. Dr. Lindley, in his "Introduction to Botany," 1832, has arranged seed-vessels into four classes, viz.: First, APOCARPI, containing four divisions, namely, *Utriculus*, one-celled; example, Amaranthus. *Achenium*, one-seeded; example, Borago. *Drupa*, one-celled, one or two-seeded; example, Plum. *Folliculus*, one-celled, many seeded; example, Pæonia. *Legumen*, a pod; example, Pea. *Lomentum*, differs from the legumen in having contractions between each seed; example, Ornithopus. Second, AGGREGATA, fruit aggregate, viz., *Etæris*, ovaries distinct; examples, Ranunculus and Fragaria. *Syncarpium*, ovaries cohering into a solid mass; example, Magnolia. *Cynarrhodum*, ovaries distinct, pericarpia hard; example, Rose. Third, *Syncarpi*, fruit compound, viz., *Caryopsis*, one-celled, one-seeded; example, Wheat. *Regma*, three or more celled; example, Euphorbia. *Carcerulus*, many celled, superior; example, Mallow. *Samara*, a key, two or more celled, superior; example, the Ash. *Pyxidium*, one-celled, many seeded; example, Anagallis. *Conceptaculum*, two-celled, many seeded; example, Asclepias. *Siliqua*, one or two-celled. *Silicula*, similar in structure to the preceding, only more rotund; example, Shepherd's Purse. *Ceratium*, one-celled, many seeded; example, Corydalis. *Capsula*, one or many seeded; example, Primrose. *Amphisarca*, many celled, many seeded, pericarpium fleshy; example, Adansonia. *Tryma*, by abortion one-celled; example, Juglans. *Nuculanum*, two or more seeded; example, the Grape.

Hesperidium, many celled, few seeded; example, Orange. *Glans*, one-celled, one or few seeded; example, the Oak. *Cypsella*, one-seeded, one-celled; example, all compound flowers. *Cremocarpium*, two to five-celled, inferior; example, umbelliferous plants. *Deplotegia*, one or many celled; differs from the capsule only in being adherent to the calyx; example, Campanula. *Pomum*, two or more celled; example, the Apple. *Pepo*, one-celled, many seeded; example, the Melon. *Bacca*, a berry, many celled, many seeded; example, the Gooseberry. *Balausta*, many celled; example, Pomegranate. Fourth, ANTHOCARPI, collective fruits, viz., *Diclesium*, one-seeded, indehiscent; example, Spinach. *Sphalerocarpum*, one-seeded, enclosed within a fleshy perianthium; example, the Yew. *Syconus*, a fleshy rachis, having the form of a hollow receptacle; example, the Fig. *Strobilus*, cone, an amentum, the eupella of which are scale-like; example, Pinus. *Sorosis*, a spike, converted into a fleshy fruit by the cohesion of the ovaria with its envelopes; example, Mulberry.

These are the names or titles by which the different forms and structure of seed-vessels are known among botanists, and which, when committed to memory, are of the greatest use in abridging descriptions of plants, seeing that a single term, properly applied, serves the purpose of very many words. The annexed are figures of fruit.





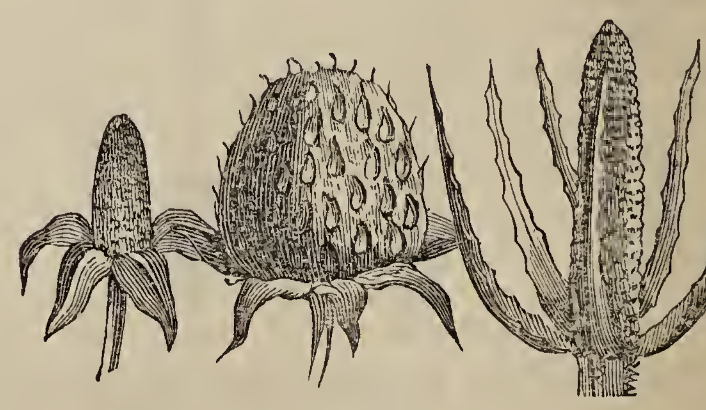
Seed-vessels are two or many valved. The junctures are called *sutures*, to which the seeds are sometimes umbilically attached. If the seeds are borne on an internal member, it receives the name of *placenta*; and if the capsule be divided by membranous partitions, these are called *dissepiments*.

The *Style* is that portion of the pistillum which, when present, serves to elevate the stigma. It is usually seated on the topmost part of the germen, and is of various lengths, sometimes protruding beyond all the other members of the flower. In form it is commonly cylindrical, and in structure tubular, to permit the descent of the influence of the pollen, which is disintegrated upon the stigma. Sometimes the style is entirely absent; in which case the stigma is seated close upon the capsule, as it appears on the poppy. As soon as the ovarium is impregnated, the style shrinks and withers away, leaving on some fruits a very small portion of its base. In many plants there is but one style, but in several of the Linnæan classes there is a plurality, so that the term polygynia (many females) is frequently used. The style and stigma are the most delicate members of the flower, being more easily injured by frost, or withered by the sun, than the other less essential organs.

The *Stigma*. This organ is always borne on the summit of the style, if the latter be present; or, in default of this, on the apex or crown of the germen or ovarium. It is the only part of a plant which has no cuticle, and when perfect, is usually covered with a thin lymph or fluid, the more readily to catch and retain the pollen discharged from the anthers upon it. In this fluid it is said the granules of pollen undergo some kind of change or solution preparatory to the descent of their influence into the ovarium. This change of the pollen has been repeatedly observed; and from the effects of foreign pollen artificially applied, there can be no doubt but that this is the course in which the sexual powers of plants are united and consummated.

The pistillum, consisting of the three divisions just described, is pretty uniform in appearance in most of the Linnæan classes, except *Syngenesia* and *Gynandria*, the *Compositæ* and *Orchideæ* of Jussieu. In the latter named order the filaments of the anthers and the style of the pistillum are united, forming a column on which both anthers and stigma are seated, but in such positions as to make the means of contact not very apparent. But diligent observers have discovered that there is not only a channel of communication, but a peculiar mechanism and elastic power in the filaments, by which a conjunction takes place with the greatest facility.

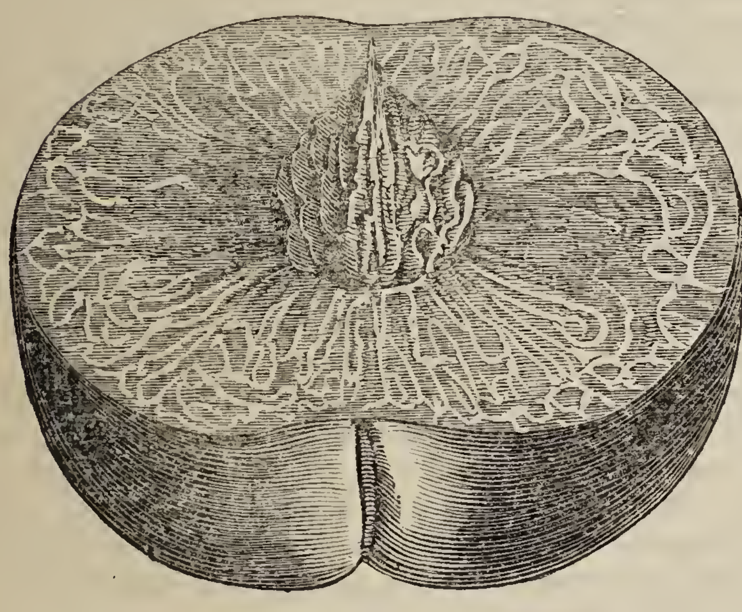
The *Receptacle*. This is the last member of the flower which remains to be noticed. It is that part on which all the other members are seated, either directly or indirectly. The calyx is usually borne on its edge; the corolla, stamens, and pistillum, on its disk. It is the termination of a fruit-bearing branch, or that of a peduncle, and is either nearly flat,



Receptacles.

elongated out in the shape of a slender cone, or enlarged into a thick fleshy cup.

The foregoing are the names of the different parts or members composing a perfect flower, but they are not all present in every flower. In some instances the calyx is wanting, or merged in the corolla, as in the tulip ; in the mezereon the corolla is absent, or it is absorbed into the calyx, which is coloured. Filaments are sometimes produced without anthers, and in some plants this defect appears to be constitutional, as the filaments are alternately barren and fertile. Some anthers have very short, or no visible filaments, they being non-essentials. The disk is often wanting, or inconspicuous, and so is the style ; but the stigma, seed-vessel, and anthers, must all be present to constitute a perfect flower in its normal or natural state. Some of these members, as has already been stated, are quickly perishable, others persisting to complete their functions. For instance, the calyx of the apple is united to the undistinguishable bases of the corolla and envelope of the ovarium, becoming a thick pulpy mass, bearing the sepals, which form the crown or eye, as it is called, of the fruit. The like is the case in the gooseberry. The strawberry is a fleshy receptacle; so is the fig. The peach, and other stone fruit, are pulpy pericarpiums composed of an outer skin (*epicarpium*), an intermediate pulp (*sarcocarpium*), and the stone (*endocarpium*), containing the ovula.



Section of a peach.

Plants which have been long in cultivation are very liable to have deformed or monstrous flowers, and for which peculiarity many receive the utmost care of the gardener and florist. This transformation happens in consequence of so many of the species and varieties of the same kinds being planted near together, and thereby allowing intermixture of the pollen of each other. High cultivation is also productive of unnatural luxuriance, particularly of the floral appendages. Not only are the sepals of the calyx, the petals of the corolla, the filaments of the stamens, all engrossed and deformed, but multiplied in some cases beyond measure. Even the pistillum itself becomes misshapen, its cuticle being dilated and produced upwards into leaf-like expansions, and coloured like the common foliage.

Naturalists have, until these few years, attributed all such transformations to excessive cultivation, and the interference of art, by which the natural condition of the vegetable organs suffer derangement. Such appearances are never seen on plants in their natural state, unless produced by the depredations of insects or other animals. Vegetable membrane is often seen unnaturally distended in consequence of wounds received on the stem, or fractured branches of the head. These distensions, however, never take the form of any other perfect organ; being mostly shapeless masses of bark and wood.

The illustration of these anomalies in vegetation, have in the modern schools of botany been advanced to a distinct branch of the science called " *Morphology*, or the metamorphosis of organs." A digest of the very curious doctrines involved in this new branch of the science, need not be entered into here ; suffice it to observe that they are founded upon what appears to be a dereliction from the general laws of nature. In all organised things, whether animal or vegetable, we find a compages of distinct members, each of which has its own place and functions. These are the vital, nutritive, conducting, preservative, and reproductive. The last is very manifest in animals; and to common understanding, the reproductive organs are as obvious and palpable as are any other of the appendages of vegetables. But it seems this idea is a mistake ; because, according to the new doctrine, the fructiferous organs of a plant have no rudimental identity, they being only accidental associations of the leaves ; that is, the calyx, corolla, stamens, and pistillum are only transformed and contorted leaves, in consequence of the shoot on which they are placed, becoming, by another accident " stunted."

It is needless to go farther by way of comment on this new view of the constitutional structure, malformations, and transformations of plants; it is a subject open to the consideration of every phytologist, who may come to such conclusion as he thinks most rational and agreeable to the laws of nature. It may just be added, however, that the morphologist succeeds pretty plausibly when employed in describing the changes of the leaves of a tulip into corolla, &c. or in doing the same with the garden poppy, till the capsule is opened displaying thousands of seeds, each of which he is bound to consider a convolved leaf, or a series of convolved atoms of leaves.

This opinion of the metamorphosis of plants having been first suggested by Linnæus,—sung of by the celebrated Goëthe—and embraced by De Candolle and other eminent botanists on the continent and in England,—has received very great attention ; but except in Dr. Lindley's " Introduction to Botany," it has not as yet received so full an investigation as the subject demands.

The foregoing descriptions of the different parts of plants, with the names given them by botanical writers, together with the accompanying figures, will serve to convey a general idea of the physiology of plants. On them the various systems of botany have been founded, as will appear in the subsequent sections of this article. But before entering on an exposition of the three most celebrated systems which have from time to time been given to the world, it may be requisite, perhaps, to advance a few observations on the growth of plants, or what is commonly called

Vegetable Life. That vegetables are organised bodies and endowed with a kind of life, is perfectly evident. Under favourable circumstances they are increased from a very small, to a considerable, and in some cases to a vast bulk. This phenomenon is commonly called growth ; and it is one of their properties which should be well understood, as well by the botanical student as by the practical cultivator of plants. It is impossible, however, to have a right conception of the accretion of vegetable bodies, without a clear understanding of the nature and properties of the membrane of which they are composed, the changes to which this is subject, and the essential qualities with which it is charged.

Vegetable membrane is not a homogeneous solid, but an aërolated mass, composed of innumerable vesicles or cells slightly attached to each other, and arranged in different forms, as the specific organisation of the plant requires. It is either extended into fibres and filaments, fig. 36, dilated into tissues, depressed into horizontal layers, fig. 37, compressed into perpendicular partitions, or disposed in regular columns. Each cell of these depositions is an insulated vesicle, having a thin, pellucid, elastic integument: originally inconceivably minute, but being capable of being distended to a limited size, but in a definite order, incident to the plant to which it belongs, and in any direction; the cells leaning, and clinging to each other, are consequently pressed into the various figures of spheres, ovals, hexagons, tetragons, cubes, or parallelopipedons. There are also intercellular spaces, which serve for conducting of fluids, or depositories of the secretions of the plant.

When the vegetable membrane is uniform in character, it is called *cellular;* when varied by being disposed into tubes and other organs, it is said to be *vascular.* The pellicles of the cells are of various consistence and properties as to durability. In the lower orders of vegetation they are mucilaginous and fugitive; in the higher orders they become ligneous; and along with the secreted juices of the plant, constitute what is called timber.

This organic structure of cells, &c., receives the nutriment necessary to the plant, consisting of aqueous and gaseous qualities extracted from the earth and atmosphere; and when combined in the aërolated fabric of the system, become elaborated and assimilated to the essential qualities thereof. By this reception of the elemental food, viz., oxygen, hydrogen, and carbon, the vessels of the system are supplied with these elastic principles; which when acted on by the heat, light, and humidity of air, intestine motion and consequent distension of the membranes take place, and thus the phenomenon of growth is exhibited.

It is only by constant attention, and the assistance of the microscope during the development of vegetable membrane, that the above stated facts can be illustrated. When first visible, it resembles a homogeneous jelly; no signs of organisation can be detected even under the best glasses: but as it acquires consistence, fibres, and ranks of cells gradually come into view; and soon afterwards the perfect structure is apparent. Hence it is reasonable to conclude that the cellular structure has form before any of the parts are visible; and that it is gradually developed as the season advances, until it arrives at its perfect volume.

This description is referable to every annual production, whether it be a single leaf, or shoot, or new layer of wood on the trunk of a tree; or whether it be a new bulb, tuber, root, or runner under ground.

The growth of an annual herb is perfected in a few weeks or months; its life is a gradual expansion, from the time it bursts from the seed till it ripens new seed, which is the last effort of the plant, and after which the whole dies. Some require a period of twenty months to arrive at full bulk and produce seed; such are called biennials. A few continue to grow for several years before they attain their perfect form to produce flowers and fruit. But in respect of the majority of shrubs and trees, there really appears no assignable limit to their growth; as their life only becomes extinct in consequence of being shattered to pieces by storms of wind.

The life of annual and biennial plants may be perpetuated by art. Sometimes by merely preventing their flowering, or by renewing them by the means of layering, or by rooting cuttings of their branches; and which layers or cuttings continue to grow for another season, and may, again and again, be preserved for several years by similar means. This expedient, however, is of little use in a practical point of view, as it is only necessary in the case of annuals which do not ripen seed in this country, nor are easily procurable from another.

Herbaceous plants called perennials, (living from year to year), produce stems and flowers, which die down after the seeds are ripe; but their roots increase and continue to live, barring accidents, for ever. In the same way the foliage, flowers, and fruit of deciduous trees are annually produced and shed; but the shoots and principal parts of the roots by which these were produced remain. The leaves of evergreen trees are shed in the second or some following year; and even the outer bark of some trees is triennially thrown off; while their interior axis of wood is permanent and remains sound for many years, according as it is more or less saturated with resinous sap, or more or less durable in quality. Thus, it is observable that all vegetables are increased by periodical expansions, some of the accretions being perishable, while others endure; some truly ephemeral, while others exist for ages. The largest tree is increased by annual additions, each perfectly distinct from all that preceded, and all that may follow. The permanent productions of this year, like all those of former years, remain, as to place and amplitude, ever after unchanged, till they fall to decay. This particularly applies to the new additions of wood, which, when once formed, undergo no further change in bulk or structure.

The longevity of trees depends upon the durability of the woody deposits. In most, if not all deciduous trees, the first formed layer or zone of wood, namely, that surrounding the pith, is the first to fall to decay. When this begins to take place, the layers, exterior to the first, decay rapidly; and though the trunk be receiving annually new layers of wood and bark on the outside they, together, do not keep pace with the destruction going on within; so that at last the trunk becomes a hollow cylinder; all the first formed layers of both wood and bark being dead, the life is compressed into a very narrow space between the alburnum and liber, and where it would ever continue, were the enfeebled trunk not laid prostrate by the tempest. This is the manner of what may be called the natural decay and death of a deciduous tree. It happens sooner or later, according to the solidity or texture of the wood, and to the conservative quality of the concreted sap with which it is saturated; and also according to the suitableness of the soil on which it is grown. The durability of fir and pine timber (except larch perhaps) depends entirely on the preservative qualities of the resinous sap, and this being usually in greater quantity at the centre than towards the exterior, the heart-wood, as it is called, is most lasting whether while the tree is standing, or after it is put to use.

The foregoing remarks include a brief description of the phenomena of vegetable growth, and involve the intricate question—what is vegetable life? From the facts adduced relative to vegetable organisation and expansion, we can only venture to assume, that, notwithstanding much may be traced to combined chemical and physical action, we must admit the existence of a vital principle which seems independent thereof; more especially in its power of existing for ages unimpaired in the bowels of the earth; and, while thus dormant, may be deemed an excitable or fermentable fluid, contained in an organised expansible body.

It is thus assumed, that all and every vegetable membrane, organ, or member, has rudimental existence before expansion. This is perfectly evident on dissection of any gross-growing plant. The flower of a bulb may be seen in the bosom of its investments long before it comes into view; so may the flowers of fruit trees be detected with the assistance of a microscope, twelve months previous to the bursting of the diminutive bud which contains them. Not only is it quite obvious that no plant whatever can come into existence unless from a seed, a sporule, or from a pre-existing part of itself, so neither can any one membrane of a vegetable body gain identity, unless from a pre-existing rudimental source.

It may be asked, what then, are all vegetable accretions only distensions or expansions? From what has been already stated, we must be of opinion that growth is nothing more or less than simple developement. Whatever vegetable, or part of a vegetable we attend to during growth, the only perceivable change is from small to greater bulk,—only from indistinct to evident and appreciable formation. The small shoot, leaf, or flower, is as perfect in its first visible state, as it is after full amplification. While the influences of air, and heat, and light, are acting on the elastic fluids of the system, the cellular and vascular membranes are elongated, and enlarged in definite order; the enlargement and inflation of the membranes being filled up by the induction of the elemental food imbibed from the earth and atmosphere.

This appears all very feasible in regard to the exterior accretion of plants; but what can be said of the interior growth—that of the new zone of wood for instance. It must be confessed that there is some difficulty here; principally because it is an invisible process. The fact that a new layer of white wood or alburnum is formed every summer, is known to every body; but whence it is derived, or how it is formed, is still involved in obscurity. By some physiologists it is supposed to be generated by the sap; which after perfect elaboration becomes coagulated into woody substance. Others suppose that the new zone of alburnum is formed by woody fibres, which descend from every bud above, in the same manner as seeds or cuttings send down fibrous roots into the earth. One contends, that it is a dilatation of the last year's alburnum; while another insists that it proceeds from the liber.

Without attempting a long drawn out refutation of the above suppositions, let it suffice to mention only a few facts bearing on some of the ideas, and a few doubts relative to others. The liber which comes into view at the end of the preceding summer, remains distinct and unchanged for many years after its first appearance; (instance the numerous layers of liber or inner bark of the common lime, or linden-tree, of which Russia mats are made) so that it is an error to imagine that the new alburnum is formed from liber. Neither is it a dilatation of the alburnum. This has been proved a hundred times by experiments of marking the last formed alburnum, which marks ever after remain undisturbed, though covered by the succeeding layers of new wood. That the new layer is formed by fibrous processes descending from the buds is plausible, if we only consider a stem or trunk of a few feet in length; but when we see the new layer of alburnum forming at the bottom of a lofty tree, almost as soon as it appears in the immediate neighbourhood of the buds, we have reason to doubt whether actual fibres can possibly reach so far down in so short a time, as intervenes between the bursting of the buds and the appearance of the new alburnum so far below. Another thing rather in favour of this notion, is, if the attachment of a bursting bud be examined, there are seen prominent bundles of fibres, apparently descending from the base of the bud, and disappearing downwards on the surface of the last year's alburnum. Whether these processes actually descend, or whether they are sap ducts, enlarged as they approach the craving outlet, is, perhaps, questionable. At any rate the supporters of this opinion must know that the buds, which burst into shoots in this year, are the production of, and attached to, the alburnum of the last year; and therefore cannot directly serve to increase the alburnum formed in this. The next idea relative to the accretion of alburnum yet to be noticed, is that which attributes the formation of wood, and indeed every other member of the plant, to the organisable property of the perfect sap. This fluid, it is said, after being elaborated in the leaves, returns down into the space between the last year's alburnum and liber; and there losing its fluidity, becomes pulpy or granulated, and by some other consolidating process is changed into a ligneous consistence, and into all the varied structure, viz. cells, tubes, air-vessels, and fibre of perfect timber.

Whether a fluid purely homogeneous, like the sap of plants, be capable of transformation into regularly organised matter, is a circumstance of which, perhaps, we have no parallel instance in nature. Even with the assistance of all the great natural agents, it is not probable that the simplest plant, or the simplest organised part of one, can come into existence fortuitously. We would therefore infer, that as all plants, and parts of plants, arise from a rudimental organised source, the new layer of alburnum has a similar origin; and that vegetable physiologists will in time be able to detect the source, and be able to show it in winter as well as in summer: for throughout the latter season, while in the state of what is called *cambium*, it is not only visible, but tangible, though wholly imperceptible to the naked eye in winter.

Having taken a brief view of the phenomenon called growth, we may next advert to that principal component of plants commonly called the sap. This is so intimately connected with vegetable structure, and evolution, that it is impossible to understand the developement of the one without appreciating the nature and uses of the other. As plants are composed of a vast assemblage of cells and vessels, fluids either gaseous or aqueous are necessary for their distension and completion. Water is the principal medium in which the elementary food of plants is conveyed to them, and for the reception of which their organs are so admirably fitted. The head of the plant waving in the air is, from the previous structure of its exterior surface liable to much waste by evaporation; this induces absorption of water at every inlet; and as these inlets are chiefly in the soil, where there is always some degree of moisture, the latter is readily received or absorbed: and hence a current upwards is generated, to supply every waste, and to fill and distend every vessel.

If the sap be drawn from the stem by boring near the root, it is found but little better than pure water; but if withdrawn from the top of the stem, or from the branches, it is found much richer in essential qualities. This is proof that the aqueous food of the plant undergoes a material change in the vascular frame of the vegetable; not only by simple admixture with the essential juices, but by assimilation thereto, by the agency of the peculiar elaborating apparatus incident to the plant. Hence we have resins, gums, acids, &c. Moreover, the elaborating powers of plants are so great, that chemists have detected chemical bodies in their juices, of which no trace could be found either in the earth or water in which they had been nourished.

The motion of the sap is visibly and principally upwards, also laterally, and downward. It is diffusible in all directions; passing into, and through every membrane where there is depletion. In this respect it is exactly like the absorption of water by a piece of sponge, or a knob of salt or sugar. In a high temperature, the sap is thin and its motion is accelerated. As heat declines, it becomes clammy, and in the cold of winter it is quite stagnant. At all times when in motion, and in sufficient quantity, it flows from wounds made through the bark; and when exposed to air either assumes the consistence of resin, gum, thick serum, or acidulous water. The recently formed layers of bark and wood, are the principal channel for the conduction of the fluids. When the first-formed parts of wood cease to act as channels, the sap becomes in them concreted in the cells and intercellular passages, giving solidity, a darker colour, and weight to the timber. This is very visible in pine timber, and easily proved by maceration in a proper acid. By such trials on oak and lignum vitæ, both colour and ponderosity are lost, and the fibrous frame only remains, as light and as fragile as that of willow. The outer layers of bark of many trees, also become, after a certain time, useless as sap ducts; and being no longer living members of the tree, retain those concreted qualities, which were deposited in their vascular substance when the sap used to traverse them:—instance oak bark.

The annual subsidence of the sap from the branched head, down in a body to the roots in the autumn, is a very old and generally received opinion; but it has never been clearly proved. There are several circumstances which appear to militate against such doctrine, and which, when stated, will enable the reader to judge how far such an idea is worthy acceptation.

The roots are never so destitute of sap, nor so capacious as to admit such an additional surcharge. The sap in the branches is not visibly diminished by such subsidence. The spring motion of the sap begins at the top of the tree; before it is at all liquefied at the bottom, which could not happen did the returning tide flow from the root. If we consider the motion of fluids in general, and in all ordinary circumstances, we invariably observe that their motions are caused by fluidity, ponderosity, or temperature; if they flow from a place which is full, it is because there is a vacant space to receive them: a rarer fluid will give place to one that is heavier; and consequently the warmest parts of a fluid will rise above those which are colder. But in all these cases an outlet or vacuum must exist, or the removal of some pre-occupying fluid must take place before any motion can be generated.

These are a few facts bearing on the question, and which must be explained away before we can fully understand how a general subsidence of the sap in autumn can possibly take place. It has been already observed, that vegetable membrane is permeable to fluids in all directions, and that the whole body of fluid sap in the autumn is of congenial quality, and equally diffusible into the roots as well as into every other part of the system; still direct proof is wanting to establish the truth of the opinion, that a *principal portion* of the sap of the head *descends* to the roots in winter.

SYSTEMATIC BOTANY.

Systematic botany has no very alluring aspect to a beginner. The great number of titles of the classes and orders, to say nothing of the generic and specific names, is a bar to commencing the study of the science. But when set about in earnest, the first difficulties quickly vanish; still much attention and time is required before such a knowledge of it can be acquired as to yield real pleasure to the student.

Initiation into this, like that of all other sciences, is laborious; stepping over the threshold is a kind of mental drudgery, and which is in fact the most irksome part of the undertaking; but when the student is fairly within the pale, the different avenues into the interior and more occult regions of the science are opened up; those thick clouds of difficulty which timidity or indolence had formed, are soon dispersed, and the student soon finds himself in an open expanse —in a new world, where he finds a thousand new objects which he can name at first sight. When this much is attained, the study becomes every day more and more interesting; every new plant is sought and examined with avidity: research is no longer toil; on the contrary, such investigation becomes delightful exercise, yielding positive pleasure; while every accession to the previous stock of knowledge is attended by fresh gratification.

The amateur botanist proceeding in this way soon acquires a competent knowledge of this pleasing science; he gradually becomes cognisant of the greater features, and gains such an insight into the details as dispels every obscurity which he thought he saw before him on his first entrance on the study. And when this much is accomplished, he enjoys every satisfaction that can arise from the knowledge of one of the most interesting branches of natural history, and which, moreover, is a necessary accomplishment of every well-educated mind.

To ladies particularly, and to the young of both sexes, the study of botany is a most agreeable exercise and amusement. Flowering plants always claim the regard of the young, of refined minds; and none are more enthusiastic lovers of fine plants than the aged botanist. For the pencil of the female artist, where can such elegance of form and delicacy of colour be found for imitation as in the parterre? or what can embellish the dwellings of the rich, or cottages of the poor, more than the floral products of vegetation?

Many are lovers of flowers who are not at the same time botanists. This feeling is as innocent as it is rational; it is a source of pleasure, but only in a subordinate degree to that enjoyed by those who to their love of flowers add scientific knowledge; who not only know the name, but can tell to what class or tribe the plant belongs—whether native or foreign—whether sanatory or noxious. No portion of human lore in natural phenomena yields more gratification to the well constituted mind than a scientific knowledge of plants.

To be a practical or professional botanist requires a long lifetime of close application and study. To store in memory nearly one hundred thousand names requires a power of retention enjoyed by few; and to nomenclature must be added acknowledge of the history of plants — their natural habitat as well as their culture: without an intimate acquaintance with these things no one can be a practical botanist.

Such a portion of knowledge is not merely a mental embellishment, nor is it merely an elegant amusement; though it may be employed as such by the affluent, yet it is in many respects eminently useful. To the medical man a knowledge of botany is indispensable; the virtues of plants are almost as various as are the genera; and their essential qualities furnish a very large proportion of materia medica. In the arts the products of vegetables are universally employed; and their value, as supplying articles of human diet, &c., hardly need be mentioned.

That both the culinary and medical uses of plants were discovered without the assistance of scientific botany, is perfectly true; but as the latter has been so much improved, discoveries for either purpose are made with much more certainty and success. There was a time when herbalism, or the study of the medical virtues of plants, was carried to an extravagant length, but since the excellent science of chemistry has been so closely united to that of medicine, the dreams and fooleries of astrological herbalism have been deservedly driven from the schools. That different plants possess different qualities is well known; and it is observable that the same qualities prevail, in a greater or lesser degree, in every species of the same genus. In this point of view, the Jussieuan system is superior to every other. This, indeed, is one of its most useful traits; because, if the predominating qualities of any one plant of a family, or, in many cases of an order, are known, it may be safely assumed that all the others partake of the same. Thus in the *Cruciformes* of Tournefort, the *Tetradynamia* of Linnæus, and the *Crucifera* of Jussieu (all different titles for the same family of plants), an acrid yet wholesome quality is found more or less in every species. Although this be pretty generally the case among the families of plants which Jussieu has placed together in the same order, yet there are some exceptions. Wholesome and poisonous plants are sometimes found in the same order; and this circumstance has been laid hold of to bring the whole *natural* system into disrepute by those who are averse to the study of it. Those opponents affirm that it contains incongruous associations, and refer to the order *Urticeæ* as a proof. It is true that in this order we find the bread-fruit, nettle, mulberry, fig, hop, &c., plants certainly very different in external form and manner of growth; but they have, besides their similar mode of flowering, some strong characteristics of affinity; for instance, the tough fibrous substances found in the nettle, hemp, hop, and others.

That the Jussieuan system is not yet perfect is true, but it is not incapable of improvement. Were it, as has been already observed, a little more abridged in its orders and in its vast number of genera by disregarding minor differences of form or position, it would be much more inviting as a study. In some of the natural families there may be groups which, compared with each other, are obviously distinct, so much so indeed as to have induced some very able practical botanists to separate them entirely from their congeners. Such intermeddling may be scientifically justifiable, but such diffusion of the system is always to be regretted, and should never be had recourse to if it can be possibly avoided. Errors or misconceptions of former authors certainly require correction, but old established genera should be cautiously dealt with.

In fine, in this improving age we have every reason to believe that no obstruction to the acquirement of pure botanical science will long remain in the way to impede the progress of the careful student. Every approach will be rendered open and every path made easy and inviting by those masters who are now so deservedly at the head of the science. It may be added that those who have no intention of aspiring to be scientific botanists may yet devote their leisure hours to a kind of botanising with great advantage and pleasure to themselves, if they have ever so small a piece of ground; or if wanting that, they may for amusement form a herbarium requiring only a few sheets of brown paper. By filling this receptacle with the commonest flowers they may gain a very clear insight into systematic botany by merely putting together every flower they meet with (whether they know the names or not,) according to its general character. For instance, collect all the bell-shaped flower (*campanula*) and place them together; do the same with the funnel-shaped (bindweed), the masked (snapdragon), the lipped (dead nettle), the cross-shaped (charlock), the rose-shaped (poppy), the lily-like (daffodil), the butterfly-shaped (broom), the compound (daisy), and so forth. Even such an attempt as this would be a pleasing and rational employment; a valuable first step to a better and more refined knowledge of plants; and which might be exercised in every walk into the garden, or in every ramble in the fields.

In entering on this part of the subject it occurs to us as unnecessary to notice any scheme previous to that of Tournefort, because, although his was not the very first, it was the first in respect of its acceptation with cotemporary botanists and kept its hold of public estimation till it was superseded by the new system of Linnæus. Tournefort founded his system on the absence or presence, the figure, situation, and proportion of the corolla. This part of the flower is always, when present, the most conspicuous and imposing; and attracted the notice of the earlier botanists (as it does that of children now) more than it really deserved; because in fact no part of the flower is more subject to incidental change than the corolla. He divided the vegetable kingdom into two principal parts, viz. herbs and trees; the primary divisions he subdivided into twenty-two classes; the first seventeen of which comprise the herbs, and the other five the ligneous vegetables; these are again separated into one hundred and nineteen sections, but without names or titles being applied to them, as in those of other botanists. The characters of these sections were not always sufficiently defined; and consequently the young botanist often met difficulties in arranging plants in their proper places.

In presenting a view of the system it will only be necessary to enumerate and name the divisions and classes, with their leading characters, which are as follow:—

DIVISION I. HERBS.

Class I. *Campaniformes.* Herbs having a simple, regular bell-shaped monopetalous corolla.—This class contains nine sections, distinguished from each other by the character of the fruit, as whether berry, capsule, folliculus, naked seeds, &c.

Class II. *Infundibuliformes.* Herbs having a simple, regular, funnel, salver or cup-shaped monopetalous corolla.—This class contains eight sections distinguished from each other by the character of the fruit.

Class III. *Personatæ.* Herbs having masked flowers, simple, monopetalous and irregular; the seeds contained in a pericarpium. This class contains five sections, differing from each other in the attachment and character of the fruit.

Class IV. *Labiati.* Herbs having lipped flowers, simple, monopetalous, and irregular, the seeds four, attached to the bottom of the persisting calyx. The sections of this class are four, differing from each other in the form and position of the upper lip.

Class V. *Cruciformes.* Herbs with cross-shaped flowers, simple, tetrapetalous, and mostly regular; the fruit a siliqua or a silicula.—This class has nine sections, founded on the shape, and number of locaments of the pods or fruit.

Class VI. *Rosacei.* Herbs having flowers resembling the rose, simple and regular, with from five to an indeterminate number of petals.—This class comprises ten sections, distinguished from each other by the character of the fruit.

Class VII. *Umbellatæ.* Herbs having their flowers disposed in an umbel, simple, pentapetalous, regular, and having two naked seeds attached to each other.—The sections of this class are nine, differing from each other by the size, shape, and markings on the seeds.

Class VIII. *Caryophyllei.* Herbs with flowers resembling the pink, simple, pentapetalous, regular, the claws of the corolla long, and attached to the bottom of a monophyllous calyx. The sections of this class are two, differing in one having a compound, and the other a single capsule.

Class IX. *Liliacei.* Herbs having flowers resembling the lily, simple, regular, monopetalous, with the limb deeply divided into six segments, tripetalous, or hexapetalous; the seeds contained in a capsule of three locaments. This class contains five sections, distinguished from each other by the pistil or calyx becoming a capsule.

Class X. *Papilionacei.* Herbs with butterfly-shaped flowers, simple, polypetalous, the fruit a legumen. This class contains five sections, differing from each other in the form, locaments, and numbers of the pods.

Class XI. *Anomalæ.* Herbs having simple polypetalous, irregular flowers, which do not conveniently fall in with any of the other of the above classes. This term, therefore, expresses only the extraordinary or irregular habit of the flowers of those plants which it contains. The sections of this class are three, distinguished by having capsules of one or several cells, formed out of the calyx or pistil.

Class XII. *Flosculosi.* Herbs with compound flowers, consisting of many tubulose, monopetalous florets, placed on a common receptacle; the stamens united by the anthers, in the second, third, and fourth sections. This class contains five sections, distinguished from each other from having no seeds(!) single seeds with a pappus, single seeds without a pappus, florets having a calyx, and the same with a calyx, but with distinct anthers.

Class XIII. *Semiflosculosi.* Herbs having compound flowers, consisting of many monopetalous, ligulate corollets, placed on a common receptacle, the stamina united by the anthers. The sections of this class are two, distinguished by having ligulate flowers, the seeds crowned with a pappus; and ligulate flowers, the seeds without a pappus.

Class XIV. *Radiati.* Herbs having compound flowers, consisting of many monopetalous corollets, placed on a common receptacle; the florets of the disk tubulose, and those of the margin ligulate. The sections of this class are five, and differ from each other by the seeds being crowned by a pappus, or palea (chaff), or naked, or contained in capsules, or having the rays composed of broad folioles.

Class XV. *Apetalæ.* Herbs having stamens and pistils, but no corolla, the calyx being the only part that envelopes these organs. This class contains six sections, having the following characters:—apetalous flowers, in which the calyx became the fruit; the same in which the pistil became a single seed; the same, but in which the seeds contained farinaceous matter, (viz. all kinds of corn and grasses); apetalous flowers in scaly heads; the same, with stamens and pistils separate on the same root, and the like on separate roots.

Class XVI. *Apetalæ et Aflores.* Herbs having neither stamens nor pistils, but only seeds on the back of the leaves. The sections of this class are two, viz. with seeds symmetrically disposed in clusters or lines on the backs of the leaves; or with seeds growing in ears, or in capsules.

Class XVII. *Apetalæ, et Aflores, et Acarpii.* Herbs having neither flowers nor apparent seeds. This class contains only two sections, viz. such as grow on the earth, or on other vegetables; and such as grow under water. This class contained the mosses, funguses, and all the algæ, except the lichens.

DIVISION II. TREES AND SHRUBS.

All plants of these characters are arranged by Tournefort in five classes, founded on their modes of flowering, and forms of the fruit.

Class XVIII. *Apetalæ.* Trees or shrubs having stamens and pistils, but no corolla. This class contains three sections; the first having stamens and pistils in the same flower; the second having stamens and pistils separate on the same plant; and the third having stamens and pistils on different roots.

Class XIX. *Amentaceæ.* Trees and shrubs having their male flowers, and some of their female flowers also, disposed in an amentum. This class contains six sections, and are distinguished by their unisexual flowers being separate and dissimilar on the same root, producing a nut; or the like on the same root, the fruit being contained in a leathery capsule; or a simple or compound berry; or in a strobilus; or in a globular scaly receptacle; or lastly, trees and shrubs with male and female amentaceous flowers on separate roots.

Class XX. *Monopetalæ.* Trees and shrubs having monopetalous, campanulate, or infundibuliform flowers. This class contains seven sections, distinguished from each other by the character of the fruit; that is, whether drupe, berry, capsule, follicle, &c.

Class XXI. *Rosacei.* Trees and shrubs having rosaceous polypetalous flowers. There are nine sections in this class, founded on the character of the fruit.

Class XXII. *Papilionacei.* Trees and shrubs having papilionaceous flowers and leguminous fruits. This class contains three sections, distinguished from each other by the character of their leaves, viz. whether simple, or pinnate, or ternate.

The above is an abridged sketch of the system of Tournefort; and is given with the view that the reader may see by what gradual steps the science of botany has risen from a chaotic mass of indistinction to its present improved state; and to show also how much is really due to the great industry of its author as a practical botanist. His labours, considering the state of the science when he lived, were indeed great, and far surpassing those of either Linnæus or Jussieu. In fact, Tournefort was pioneer to both; and amassed, and in many cases assorted to their hands, the materials of which both their systems are formed.

THE LINNÆAN, OR SEXUAL SYSTEM.

The sexuality of plants had been discovered long before the time of Linnæus. But as far as is now known, he was the first who suggested the idea of classifying plants according to the numbers, connection, and stations of the male and female organs. From the moment the idea occurred to him, he was indefatigable in the completion of a system which he, no doubt, fondly flattered himself was founded in nature. His great acquirements as a scholar, his love of natural history, his station among learned men, and his connection with many learned societies, eminently fitted him for achieving this great and laborious work.

The plan of the Linnæan system of botany was intended to comprehend the whole vegetable kingdom, and which was arranged in two grand divisions, namely, plants having visible flowers (*Phænogamia*), and plants having no visible flowers (*Agamia* or *Cryptogamia*).

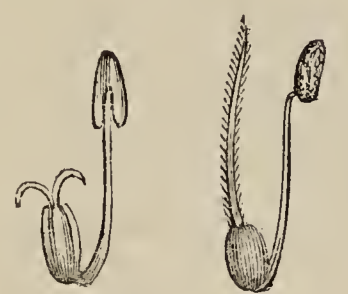
The first grand division comprises twenty-three classes, founded on the number, the position, and stations of the stamens and pistils. The first eleven classes proceed in an uninterrupted series, from one to twelve stamens, and are named respectively from their number. The titles or terms used to express the classes, are compounded of the Greek numerals and the word *andria*, signifying man. These classes are subdivided into orders, which are designated from their number of pistils by Greek numerals also, with the addition of the word *gynia*, which signifies woman. There being no plants which have invariably eleven stamens, this class in the order is called *Dodecandria*, and contains all plants having from eleven to nineteen stamens. The twelfth class is known from having twenty or more stamens, seated upon the corolla or calyx, and which sufficiently distinguishes it from the thirteenth class, which has also twenty or more stamens, but these are seated on the receptacle or base of the flower.

The fourteenth and fifteenth classes are distinguished, not by the number of their stamens, but by their unequal length: the first has four stamens, two of which are longer than the others. This class is further distinguished from having invariably ringent, that is, gaping flowers. The fifteenth class has six stamens, four long and two short, with one pistil and cross-shaped flowers.

The sixteenth class is known by having the filaments united in one body at the bottom, and without regard of their number. The seventeenth class has stamens united in two sets, and is otherwise easily known from having also papilionaceous flowers. The eighteenth class has its stamens in three or more sets. The nineteenth class contains all the compound flowers, and a few other genera having single flowers. The leading character of this class is in the anthers being united in a cylinder round the style. The twentieth class is known by having its anthers growing on the pistil, and not on the receptacle. The twenty-first class has male and female flowers separate, but on the same plant. The twenty-second has male flowers on one plant, and females on another. The twenty-third class contains those genera which have not only unisexual flowers on different plants, but also bisexual flowers intermixed. The twenty-fourth class contains all plants whose flowers are inconspicuous. To these Linnæus added another class, which he called *Palmæ*, the flowers of which were not sufficiently known in his time to admit of their being properly placed in the system.

The foregoing is a general sketch of the classes of the Linnæan system; we have next to present a view of the subdivisions or orders of each class, which, with figures of the parts on which the distinctions are formed, will give as clear a view of the system as is consistent with the plan of this article.

The first class, Monandria, having one stamen, contains only thirty-three genera, and two hundred and fifty species. Some of the genera, as the *Cannas* and *Hedychiums*, are highly ornamental exotics; and the *Zingiber officinale*, the common ginger, is an important article of commerce; both seeds and roots of many plants in this class are used in medicine, as well as by the dyer, as galangale, turmeric, arrowroot, and zedoary. Their predominating qualities are aromatic. They are chiefly reed-looking, herbaceous plants, with large leaves and showy flowers. Several of the genera are British, as centranthus, glass-wort, mares-tail, and wrack-grass. The mares-tail, *Hippuris*, is a curious plant, not uncommon in ponds and ditches. It has a single jointed stalk, and at each joint are twelve or more linear leaves, placed verticillate or in a whorl. To each of these leaves, and close to the stalk, sits a little flower consisting of a single stamen and pistil, one seed and nothing more; both calyx and corolla being wanting. All the plants alluded to above are in the first order, Monogynia, they having only one pistil. In the second order, Digynia, having two pistils, there are seven genera, one of which is the *Callitriche*, or water starwort, which is also an aquatic, being frequently met with in ditches. There is another plant, sometimes sown in flower borders as an ornamental annual, which belongs to this order. Its chief ornament is its fruit, which are thickly set on its branches, resembling strawberries: hence it is called strawberry blite,—*Blitum capitatum*. The sexual distinctions of this first class, with the two orders, are represented thus:—



Class Monandria.

The second class is Diandria, that is, flowers having only two stamens. There are sixty-one genera in this class, and which are divided into three orders.

The first order, Monogynia, having one pistil, contains by far the greater number of the genera. Here we find the useful olive, the beautiful and fragrant jasmine, and many fine evergreen shrubs. The lilac, the fringe tree, and catalpa, also belong to this order. Nor are the herbaceous plants found here less prized. The wild and cultivated speedwells, the delicate schizanthus, the showy justitias, and the elegant slipperworts, are some of the choicest gifts of Flora. The rosemary, and numerous species of sage, those fine medicinal plants, are ranked in this order. Some botanists have suggested the removal of this last named genus to the class *Didynamia*, because, although there be but two perfect stamens, there are the rudiments of two others in the flower. "The structure of the stamens in the sage is singular: the two filaments are very short, but two others are fastened to these transversely by the middle; and at one end of these is a gland, at the other an anther. This circumstance distinguishes the genus from all others, and is called its essential character."

Class Diandria.

In the second order, Digynia, plants with two pistils, there are only three genera, and they are properly grasses. Here we find the sweet vernal grass, *anthoxanthum odoratum*, which so greatly assists to give to hay its agreeable scent. It is also one of our best pasture grasses, and much cultivated.

In the third order, Trigynia, that is, plants with two stamens and three pistils, there are only two nearly allied genera, namely, the pepper and *peperomia*. The first is universally used as a spice; is extensively cultivated in India, and is a most important article of commerce. Even the leaves of *Piper Betel* are a necessary of luxury, if not of life, in India, being used to chew along with the betel-nut of that country.

The distinctions of this class and order are graphically annexed.

The third class of the system is Triandria, and which contains three orders. It comprises two hundred and seven genera and one thousand five hundred and forty-nine species. The plants arranged here are of the most interesting character. They form the general verdant covering of the earth, affording pasturage for our flocks and herds at almost all seasons, and fodder when the fields are buried in snow. Almost all the useful plants, significantly called *cereals*, are found in this class; the "staff of life," and all the different sorts of grain which serve to feed and to fatten the animals which serve for our "sport or gust," are derived from one or other of the triandrious class. In bulk the grasses are so diminutive as aggregately to form the compactest carpet-like turf; and on the other hand, on the banks of lakes and rivers they grow up into impenetrable reedy thickets. Nor are the other genera ranked here less remarkable for the beauty of their flowers than are the cereals for their usefulness. The well-known crocus, the corn-flag and iris, and many allied foreign genera, are among the chiefest ornaments of our gardens, and which compensates in some measure for their want of usefulness when compared with their associates the cereals. No class shows more decidedly the artificial character of the Linnæan system than this; for assuredly the iris and wheat can claim no congeniality with each other, either in external structure or constitutional properties; but these having each three stamens compelled the author to place them together.

Class Triandria.

The class is divided into three orders, Monogynia, Digynia, and Trigynia, the first having one pistil, the second two, and the third three. The second order, Digynia, contains most of our common grasses, as millet, panic grass, bent grass, fox and cats' tail, oat and cocks'-foot grasses, besides wheat, barley, &c., together with the far-famed sugar cane, that source of wealth to the tropical planter, and indispensable condiment in the diet of all nations.

The third order, Trigynia, contains only twelve genera, most of them and and water annual weeds:

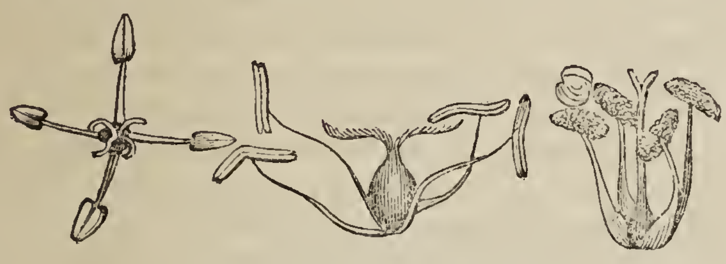
some are curious or pretty, but none are cultivated out of botanical collections.

The fourth class is TETRANDRIA, containing all plants having four stamens of *equal length*. This distinction should be specially kept in mind by the student, because the fourteenth class (*didynamia*) has also four stamens, but in this last two are longer than the others.

This class is divided into three orders, namely, MONOGYNIA, DIGYNIA, and TETRAGYNIA, according to their number of pistils respectively. The whole contains above one hundred and nineteen genera and one thousand and twenty-seven species in the recently published lists. Many of the genera of the first order are beautiful shrubs and trees, chiefly natives of the Cape of Good Hope and New Holland, as the *Proteas, Hakias, Banksias*, and the splendid waratah or *Telopia speciosissima*. Several fine ornamental Chinese shrubs, as the ixoras, for instance, belong to this class, as well as many hardy plants, both shrubs and herbs, natives of Europe.

The second order contains only four genera, one of which is a British annual, *Buffonia tenuifolia*, named after the celebrated naturalist the Count de Buffon. The witch-hazel, a hardy North American tree, is also placed in this small order.

The third order, TETRAGYNIA, is also small, containing only eleven genera. Among these, however, we find the well-known holly, or holme-tree, as it used to be called in former times. This as a hedge plant is unrivalled; and as an ornamental evergreen, none are more worthy a place. Its timber, when it has attained full size, is solid, white, and of remarkable fine grain, and much used by musical instrument makers and other artists. The common pond weed, *Potamogiton*, so frequent in our slow running rivers, also belongs to this order.



Orders of the fourth class.

The fifth class of the system is PENTANDRIA, that is, flowers having five stamens. It is divided into six orders, namely, MONOGYNIA, DIGYNIA, TRIGYNIA, TETRAGYNIA, PENTAGYNIA, and POLYGYNIA. This class contains, perhaps, more phœnogamous plants than any other in the sexual system. The genera amount to above five hundred and twelve, and the described species are above four thousand and seventy-three. The first order is particularly abundand both in genera and species; every description of flowering plant is found here, trees, shrubs, and herbs, terrestrial and aquatic, trailers, creepers, and climbers, annuals, biennials, and perennials, deciduous and evergreen, tender and hardy. Among this great crowd of vegetable beauties, it is difficult to particularise any one as more typical of the class and order than another. Suffice to notice that among the herbs the primrose and convolvulus are conspicuous, among the shrubs are the beautiful azaleas, and of trees the allamanda and Portlandia are the most splendid in the tropical groves. Of medical plants there are many; one only need be mentioned, namely, the Jesuits' bark tree, *Cinchona officinalis;* and of dietetic plants there are many; instance the plantain tree of India, and the cultivated potato of Europe.

The second order, DIGYNIA, contains all plants having five stamens and two pistils. This is also a large order, and comprises many beautiful and useful plants. Here we find the *Asclepias*, with its curiously constructed flowers, and the no less remarkable *Stapelia*, a family of leafless plants, but bearing flowers of uncommon character both in shape and colour, and moreover diffusing a scent so loathsome that blow-flies lay their eggs on the petals! Here also we find the remarkable English parasitical plant, the dodder, *Cuscuta Europæa*, and the stately elm tree, so useful both for ornament and timber. Many medicinal plants are also in this order, and not a few are useful to the cook and confectioner.

The third order, TRIGYNIA, contains only eighteen genera, some of which are well-known plants. The laurestine is one of the most ornamental, and the elder, though a common intruder, is nevertheless useful in some respects; both wood and pith are employed in the arts, and the fruit supplies the labourer with a homely kind of wine. The sumach family, so variously useful in the arts, is also ranked here, with several other genera of inferior note.

The fourth order, TETRAGYNIA, contains one genera only, and which happens to be a British plant, a beautiful inhabitant of our bogs and marshy ground, known by the name of grass of Parnassus. There are four species of this plant already described; three of them are natives of North America.

The fifth order, PENTAGYNIA, contains nineteen genera, among which we find the highly ornamental family of *Crassula*, a tribe of succulent plants, chiefly from the Cape of Good Hope. Here also we find the superlatively useful flax, which furnishes the raw material of the linen manufacture; the neat thrift, used for the edgings of walks in gardens, and the showy sea lavender.

The sixth and last order, POLYGYNIA, that is having many pistils, is a small order containing only three genera, two of which are exotics, and the other a native of Britain, common in corn-fields, called *Myosurus minimus*, or mouse-tail.

Class Pentandria.

The sixth class is HEXANDRIA, and is divided into four orders, namely, MONOGYNIA, DIGYNIA, TRIGYNIA, and POLYGYNIA. It contains two hundred genera and above one thousand seven hundred and twenty-seven species. This class contains the greater number of our bulbous flowering, and culinary plants, as the showy narcissus, the splendid lilies, the long-lifed American aloe, the magnificent erinums, and pancratiums; the unequalled fruit the pine-apple, and the equally useful onion, asparagus, &c. &c. The plants are chiefly herbaceous, are found in every clime from the torrid to the arctic zone, in the burning sands of Africa, and from under the snows of Siberia.

The first is by far the largest order, containing nine-tenths of the whole class.

The second order, DIGYNIA, contains only three genera, but one of them is most important to the inhabitants of tropical countries, and to those of the warmer parts of the temperate zones. Rice is the staff of life in India, and is cultivated on every spot of level ground where there is a command of water for irrigating the crop. Its quality as a grain is highly nutritious, and at the same time easily prepared for use. A wooden pestle and stone mortar is only necessary to free it from its rough husk; and when winnowed, simple boiling with the addition of a little salt prepares it as a principal article of food for both rich and poor. This plant is a true cereal, and has been properly placed by Jussieu among the grasses. The only British plant in this order is the *Oxyria reneiformis*, mountain sorrel.

The third order, TRIGYNIA, contains a few bulbous and tuberous stemmed plants, as the birds' tongue, the elegant trillium, and the meadow saffron, a common English plant, as well as the well-known dock.

The fourth order is POLYGYNIA, comprising only four genera, among which we find one of the most beautiful British genera, namely, the water-plantain. It is only found in pools or turfy bogs, and if cultivated it must have a place in the aquarium.

Class Hexandria.

In studying the plants of this class care must be taken not to confound them with those of the fifteenth class (*Tetradynamia*), which also has six stamens. The distinction is this: in *Hexandria* the stamens are of equal length, whereas in the fifteenth class four are longer than the other two. But besides, the structure of the flowers of this latter class sufficiently distinguish them from the former.

The seventh class is HEPTANDRIA, and contains four orders, which together comprise fifteen genera and forty-eight species. The first order is the largest, and contains two nearly allied genera of trees, viz., the æsculus and pavia, better known by the name horse-chestnut. They are among the most ornamental of our forest trees, though they are not native foresters. The flowers of the common sort are well known, and one or two of the pavias have bright red flowers, which are most striking objects in ornamental scenery. The common horse-chestnut yields great crops of nuts; but except deer, no other domestic animal will touch them.

Class Heptandria.

Class Heptandria.

Order second, DIGYNIA, contains only one genera, namely, the *Limeum Africanum*, a perennial herb from the Cape of Good Hope.

The third order, TETRAGYNIA, comprises only two genera, *Saururus*, lizard's tail, and *Astranthus*, a new genus lately introduced from China.

The fourth order is HEPTAGYNIA, that is plants having seven stamens and seven pistils. It is remarkable that among above three thousand genera only one should occur with seven stamens and seven styles; indeed, as J. J. Rousseau says, nature has neglected the number seven in her arrangement of vegetable structure.

Class eight is OCTANDRIA, which contains four orders, seventy-seven genera, and one thousand and fifty-nine species. Many beautiful plants are ranged here; of those the heaths are the most conspicuous and numerous. Of this family alone there are five hundred and forty-three species already described, chiefly natives of the southern parts of Africa. A few are found in Britain, and several in other parts of Europe. The curious *Rhexia*, the gay, and night-flowering *Œnothera*, and the elegant *Fuchsia*, are found in this class. So also is the well known mezereon, and many exotic genera of great beauty.

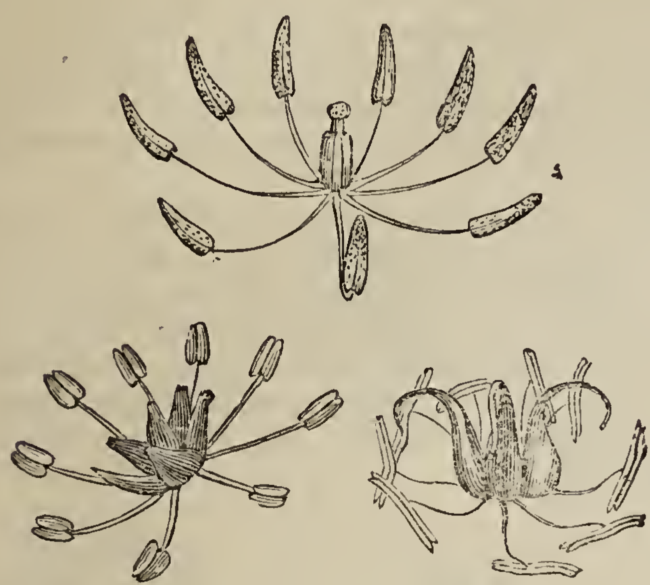
The second order, DIGYNIA, contains only five genera, all exotics, *Weinmannia* being the chief.

The third order, TRIGYNIA, comprises nine genera, among which the sea-side grape, and soap-berry of the West Indies, are the most remarkable.

The fourth order, TETRAGYNIA, contains six genera, among which is the curiously organised *Bryophyllum*, which bears viviparous progeny on the edges of its leaves. The two little interesting British plants, *Paris* and *Adoxa*, are also placed in this class and order.

Class Octandria.

The ninth class, ENNEANDRIA, is furnished with nine stamens, and contains but a limited number of plants. It is divided into three orders, comprising, together, ten genera and seventy species. In the first order, Monogynia, we find the useful and fragrant cinnamon, and the famous genus laurel, whence so many medicinal oils, and other useful substances are extracted.

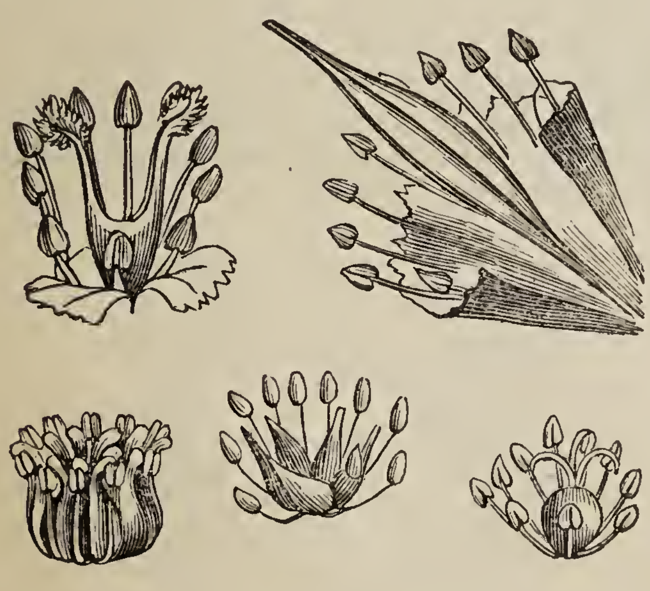


Class Enneandria.

In the second order, Trigynia, we find the excellent medical and now culinary plant rhubarb, with only one other congener, the *Pleca,* a rush-looking genus from Carolina.

The last order is Hexagynia, containing but one genus, of which there are only two species, the flowering rush of Britain and the broad-leaved ditto from Nepal.

The tenth class is numerically named Decandria, and contains five orders, one hundred and eighty-six genera, and above one thousand six hundred and forty-eight species. This class comprises a great many of our finest flowering shrubs and trees, especially those splendid kinds from North America, commonly called *par excellence* American plants. In the first order Monogynia, we have the *Kalmias, Ledums, Rhododendrons, Andromedas,* &c., plants as generally admired as they are universally cultivated: we have also the arbutus, clethra, the fine aromatic scented storax tree, and many other exotics of the greatest beauty.



Decandria and orders.

In the second order, Digynia, we find the well-known *Hydrangea,* the extensive genus *Saxifrage,* and the equally extensive family of *Dianthus,* which include the highly estimable carnation, pink, sweet-william, and other species and varieties of that favourite tribe.

The third order, Trigynia, contains a great many plants which are allied to the *Dianthus* family. They are mostly slender annual weeds, though many are pretty and a few ornamental. The catchflies, stitchworts, and sandworts are all found here, and constitute a great majority of the order.

The fourth order, Pentagynia, contains a good many plants, both native and foreign. The *Cotyledons* and *Oxalises* of the Cape of Good Hope, and the *Sedums* of Europe are most numerous. The lychnis and mouse-ear chickweed, together with the common spurrey, are also placed here.

The fifth order, Decagynia, that is, plants having ten pistils as well as ten stamens, contains only one genus, and that a foreigner, namely, *Phytolacea,* of which there are nine or ten species.

The eleventh class is called Dodecandria, there being no plant yet discovered with eleven stamens, and all those of this class have at least twelve. It contains seven orders, forty-nine genera, and four hundred and twenty-four species. The first order, Monogynia, among many fine tropical plants, includes the celebrated fruit tree, mangosteen, said to be the most delicious and wholesome fruit in the world. The garlic-pear, and the showy British plant which ornaments the banks of our rivers during summer, the *Lythrum salicaria,* are also in this order.

The second order, Digynia, contains only two genera, of which the British plant agrimony, common on road-sides, is one.

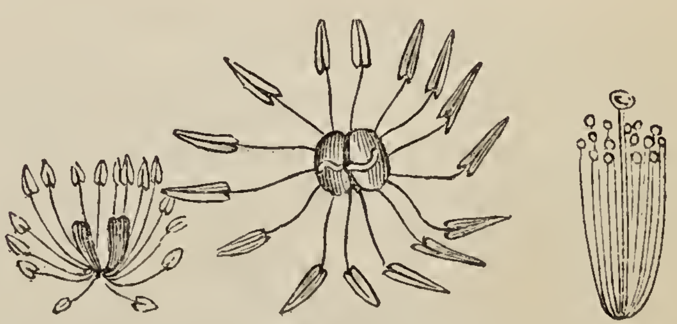
The third order, Trigynia, contains the genus *Reseda,* some species of which are used by the dyer for producing a yellow colour: another species is the universal favourite, mignonette, cultivated entirely for its scent. This order also contains the remarkable and extensive family of *Euphorbia* or *spurge,* a majority of which are exotics, though there are twelve or thirteen found wild in Britain, of which the caper-spurge and wart-wort are well known.

The fourth order, Tetragynia, contains only one genus, viz. the *Calligonum pallasia,* a native of the Caspian.

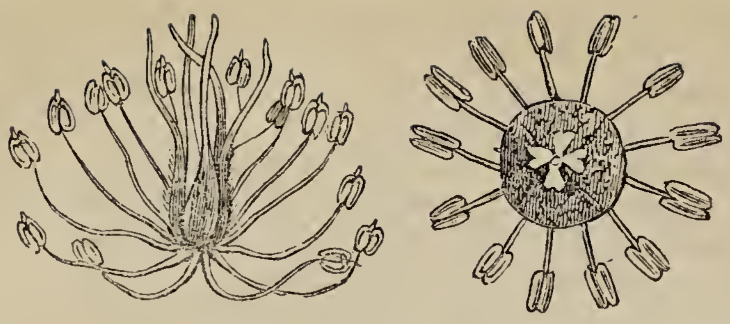
The fifth order, Pentagynia, contains only three genera, of which the *Blackwellias* are the principal. They are all, except one, tropical shrubs.

The sixth order, Hexagynia, contains a single genus, viz. *Cephalotus,* but that a very curious one; its leaves being formed into elegant pitchers, furnished with lids, like those of the *Nepenthes.*

The seventh and last order, Dodecagynia, contains only two nearly allied genera, viz., the sempervivum or house-leek, and the monanthus, a succulent plant, from the Canary Islands, bearing but one flower at a time.



Dodecandria and orders.

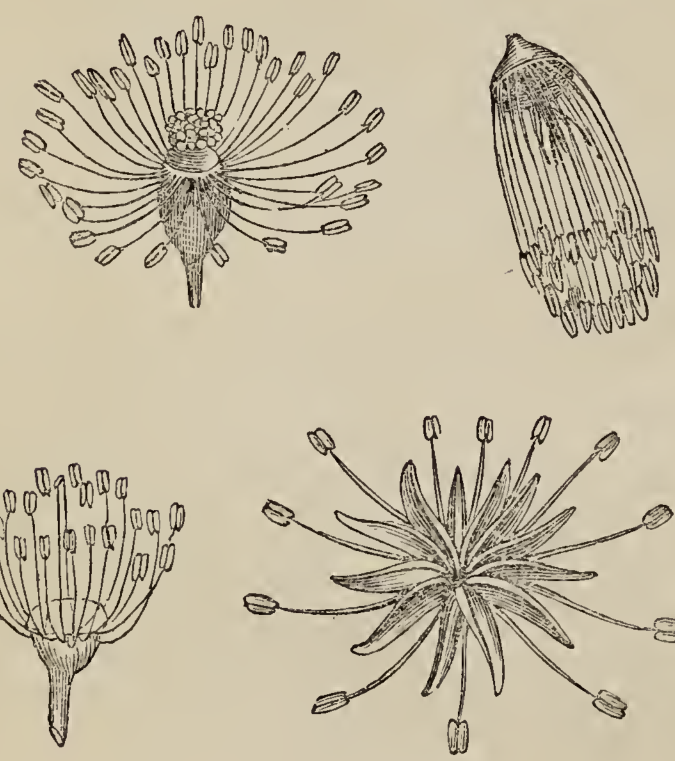


Class Dodecandria and orders.

The twelfth class, Icosandria, contains all such plants as have twenty or more stamens seated upon the corolla or calyx. It is divided into three orders, comprising sixty genera, and one thousand two hundred and ten species. This is one of the most important classes of the Linnæan system, as containing many of our most useful fruits, as well as most esteemed flowers. In the first order, Monogynia, we have the gorgeous *Cacti*, *Cereus*, *Epiphyllum*, and *Opuntias;* the myrtle, *Eugenia* and *Eucalytus;* of fruits we have the guava, pomegranate, and several of our best wall-fruit.

In the second order, Di-Pentagynia, that is, plants having from two to five pistils, we have the pear, apple, quince, &c.; likewise the extensive genus *Mesembryanthemum*, of which there are three hundred and thirteen species, besides numerous varieties described by the late lamented Mr. Haworth.

In the third order, Polygynia, we have the unrivalled rose, the exquisite strawberry, raspberry, and many others of great worth and beauty.



Class Icosandria and orders.

The thirteenth class is Polyandria; that is, all plants having an unlimited number of stamens distinct from each other, and seated on the receptacle. This class contains one hundred and seven genera, and nine hundred and fifty-six species.

The first order, Monogynia, comprises, among many others, the caper-tree, the well-known poppy, the curious sarracenia, and the magnificent water-lily.

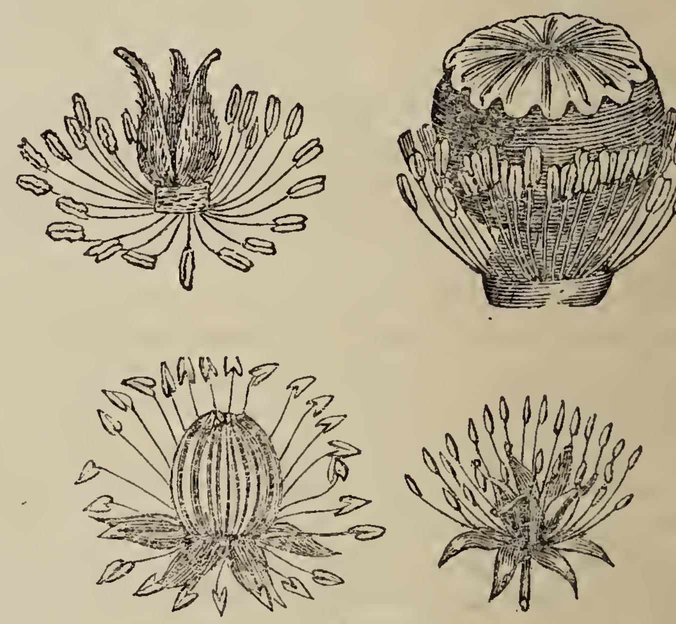
The second order, Digynia, is well typified in the splendid peony, a genus which has been lately much increased by new varieties received from China and Siberia.

The third order, Trigynia, contains the beautiful larkspurs, the dangerous aconite, and the inodorous Hibbertia.

The fourth order, Tetragynia, contains only two genera; the butter nut, a tropical fruit; and the *Drimys winteri*, a tree alied to the magnolia.

The fifth order. Pentagynia, contains ten genera, of which the well-known columbine may be taken as a type.

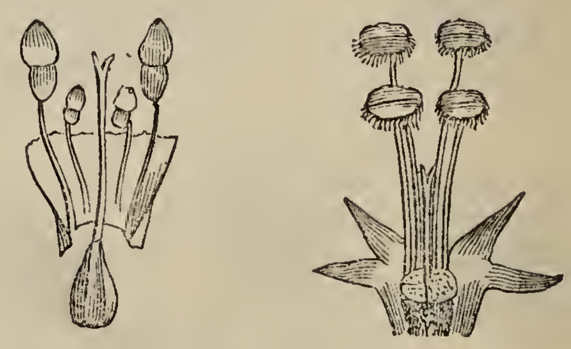
The sixth order, Polygynia, contains a great many fine flowering plants, both shrubs and herbs; among the former, the magnolia is most conspicuous; among the latter, the anemone and ranunculus are confessedly beautiful. Of early, or winter flowering plants, the aconite and hellebore are examples, and the globe-flower and marsh-marigold are showy plant.



Class Polyandria.

The fourteenth class is called Didynamia, because of four stamens two are superior, and contains two orders, one hundred and seventy genera, and one thousand four hundred species. The flowers are generally ringent.

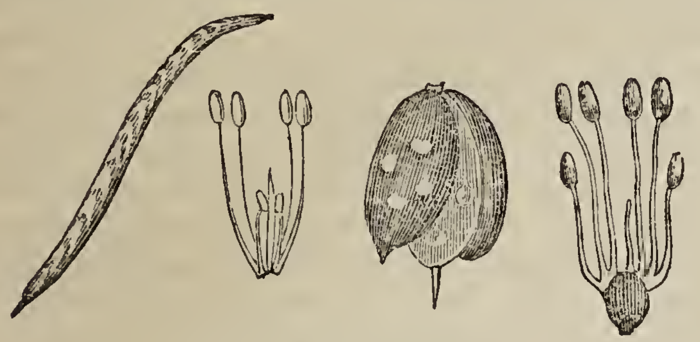
In the first order, Gymnosperma, the calyx is persisting, and becomes the seed-vessel, in which the seeds lie naked. In this order we find the germander, lavender, mint, and dead-nettle, and many others of similar character: several of them are useful in cookery.



Class Didynamia and orders.

The second order, Angiosperma, so called because, though the stamens are the same in number and position, the seeds are differently disposed, being contained in a capsule. Many of the plants in this order are very beautiful; for instance, the bignonia, volkameria, antirrhinum, mimulus, &c. The common fox-glove, so conspicuous in our hedge banks, also belongs to this order, and is a good type of the whole.

The fifteenth class is TETRADYNAMIA, so called because of six stamens four are longer than the other two. There are no orders in this class, the orders siliculosa and siliquosa being exploded; all the flower being similar in structure, and is a truly natural association, and forms the order *Cruciferæ* in Jussieu's system. Many of the plants are dietetic,



Class Tetradynamia.

as the cabbage, turnip, radish, &c.; and some are finely scented and favourite flowers, as the wall-flower, stock, arabis, rocket, &c. The seeds of several cruciferous plants yield oil of excellent quality.

The sixteenth class is called MONADELPHIA, because the stamens are united in one set. It is divided into seven orders, founded on the number of the stamens, not on that of the pistils, as in other classes; the whole containing one hundred and thirty-nine genera, and one thousand four hundred and thirty-six species.

The first order, TRIANDRIA, contains all such flowers as have three united stamens. In this we find several beautiful Cape bulbs; as the *Feraria*, *Tigridia*, *Herbertia*, &c. The flowers are not only of uncommon forms, but curiously spotted or streaked with dark colours.

The second order, PENTANDRIA, has five stamens united in one set. Of this order the passion-flower is the most remarkable type. There is also the *Erodium* or heron's-bill, a section of plants formerly united with the geraniums.

The third order, HEXANDRIA, has six stamens united in one set. This order contains but one genus, and is so distinct in itself, that it forms an order in the natural system. It is a bulbous-rooted plant, having grass-like leaves and curious flowers. This plant was unknown to Linnæus.

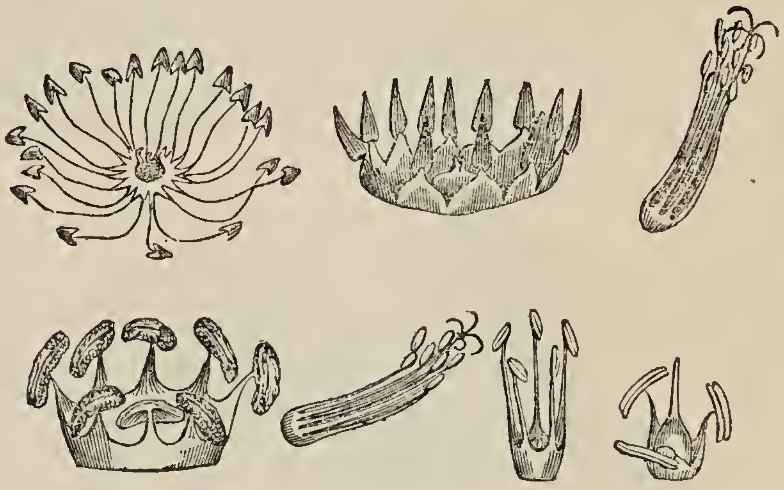
The fourth order is HEPTANDRIA, plants furnished with seven stamens united together at the base. The order contains the pelargoniums, commonly called geraniums; a genus of plants unequalled for immense variety of forms and colours. Of pelargoniums there are above two hundred and thirty-eight species, and between three and four hundred varieties already enrolled in books. They are chiefly natives of the Cape of Good Hope, and have long formed a large majority of our green-house plants. They are, perhaps more than any other tribe, very susceptible of hybridisation, and consequently every day presents new varieties or subvarieties. Many of them have tuberous roots, by which they are easily propagated, but the greater part are under shrubs.

The fifth order of the class is OCTANDRIA, and contains only two genera, which have eight stamens united in one set or brotherhood. The first genus is *Aitonia*, named by Linnæus in honour of the late William Aiton, esq., royal gardener at Kew. The second is *Comosperma*, hairy-seeded shrubs from New Holland.

The sixth order is DECANDRIA, plants having ten stamens in one set. Here we find the true geraniums or crane's-bill. These are chiefly herbaceous plants, and found in many parts of the temperate latitudes. The herb-Robert, is a common British plant, and is a good type of the genus. This order is, however, rich in showy plants of very differently constructed flowers, called *Papilionaceous*, or butterfly-shaped, and their seed-vessels being pods. Hence we findhere the crotalarias, the common furze, broom, genista, laburnum, rest-harrow, lupine, and many other beautiful plants, as well trees, shrubs, and herbs.

The seventh order is DODECANDRIA, containing plants which have twelve stamens in one brotherhood. This order comprises twelve genera, some of them highly ornamental, but they are all tropical plants.

The eighth order is POLYANDRIA, that is, flowers having many stamens united in one set. Here many of our gayest flowering plants are arranged—as the althea, lavatera, hibiscus, sida, silk-cotton-tree, the tea-tree, and its magnificent congener the camellia, now so common an ornamental favourite in British gardens.



Class Monadelphia and orders.

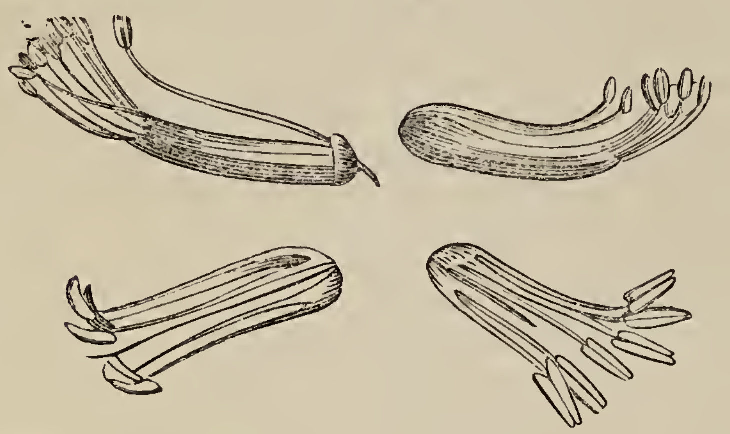
The seventeenth class is DIADELPHIA, that is, all flowers having two sets or brotherhoods of stamens. In general nine are united together, with a single one by itself, which is accounted the second brotherhood. This class contains one hundred and twenty-nine genera, and one thousand five hundred and six species. The flowers are chiefly butterfly-shaped and the whole class has a very distinct character.

The first order is PENTANDRIA, that is, five stamens united in two sets. This order contains only a single genus, namely, the *Monniera trifolia*, an African annual of no great beauty.

The second order is HEXANDRIA, consisting of plants bearing six stamens in two brotherhoods. This order contains six genera, of which the common weed fumitory is a good example.

The third order of this class is OCTANDRIA, containing flowers having eight stamens in two sets. This order comprises only four genera, of which the beautiful milkwort is the most numerous and conspicuous. The common one of this country is oen of the most interesting; found on chalk hills or other dry places.

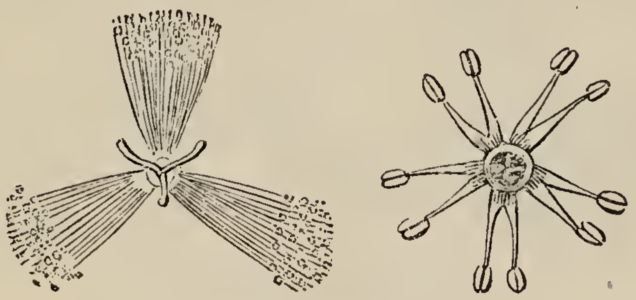
Order the fourth is DECANDRIA; plants having ten stamens united in two sets, usually nine together, and one by itself above the others. The order contains the greater number of the leguminous plants, or such as bear pods. They have all butterfly-shaped flowers; and comprise almost all our most useful kinds of pulse, forage plants, dyes, and many beautiful and valuable shrubs and trees. The pea, bean, tare, indigo, are examples of the order.



Class Diadelphia and orders.

The eighteenth class is POLYADELPHIA, containing all plants having their stamens arranged in many brotherhoods. It is divided into two orders, and contains twenty-one genera and one hundred and eighty-seven species.

The first is DECANDRIA; flowers with ten stamens in several distinct bundles or sets. Here are only four genera, all tropical plants; among them we find the *Theobroma*, which yields the useful chocolate nut.



Class Polyadelphia.

The second order is POLYANDRIA, comprising plants whose flowers have many stamens in many distinct sets. This disposition of the parts on which the order is founded, is exemplified in the St. John's wort, a plant common in our fields as well as gardens. And in green-houses the useful and beautiful fruit-tree, the orange, affords a ready example.

The nineteenth class of the Linnæan system is SYNGENESIA, and contains all the compound flowers or *Compositæ* of Jussieu. The meaning of the title signifies to generate together: the seed-bearing florets being all crowded together on the same base or receptacle: or, more probably, from the circumstance of the stamens being united in a cylinder, and surrounding the style near its apex. The peculiar arrangement by which syngenesious flowers are distinguished from all others is this, that besides the union of the anthers, the flowers or florets, instead of standing singly, are here congregated; instead of each having a calyx and receptacle, one calyx and one receptacle is common to the whole, whatever that number may be. The whole together is called the flower, as that of a daisy: the separate parts composing the disk of it, are called florets. The flower is supported on its exterior by a number of scale-like leaves, by some called calyx, but by others *anthodium*, and mostly attached to the outer rim of the receptacle, which bears the florets on its upper surface. The florets however are not always perfect in themselves; some of them are of two sexes, others, male, or female, or neuter. On the difference of these in position and character, the orders of the class are founded. The florets are said to have a calyx which is superior, and becomes the crown of the seed; a corolla which is of one petal and superior; the limb campanulate, or ligulate; stamens five, filaments inserted into the tube of the floret; anthers united by their margins in all bisexual florets; germen inferior, being a naked seed crowned with the other parts; style erect; stigma in two parts, each revolute and divergent; seed single, either naked, or crowned with the calyx, or with a pappus to assist the dispersion. The dandelion and thistle are familiar examples. This class contains two hundred and seventy-seven genera, and two thousand six hundred and fifty species.

The first order is ÆQUALIS in which all the florets are of two sexes. This is a very extensive order and contains many very common plants, as the sowthistle, lettuce, hawkweed, burdock, artichoke, &c., &c. The chief part of them are herbs, and many are annuals.

The second order is SUPERFLUA, here we find plants the flowers of which have the florets of the disk

Superflua Æqualis.

bisexual, and those forming the rays female, but which are impregnated by the anthers of the disk. This circumstance was considered by Linnæus as superfluous, and hence the title. This is also a very large order, and contains many useful as well as beautiful plants. Of the first tansy and chamomile are examples, of the second the helichrysums, xeranthemums, and dahlias.

The third order is FRUSTRANEA, so called because the florets of the disk are bisexual, and those in the ray or margin neuter. These last, having sometimes the rudiments of a pistillum, but no other sexual organ, are said to be ineffectual or frustrated polygamy. The type of the order is the splendid sunflower, with which many of the same style of flowering plants are arranged, such as the rudbeckia, coreopsis, &c.

The fourth order is called NECESSARIA, because the florets of the disk or centre of the flower, being all male, it is necessary that those of the ray or margin should be female, in order that there may be perfect seed, and which is found to be the case in all plants ranked in this order. Calendula and arctotis, exotics chiefly from the Cape of Good Hope, are two of the most conspicuous genera in this order.

The fifth order of Syngenesia is called SEGREGATA, because the florets have each its proper calyx (different from the perianthe of the floret) besides the common anthodium or exterior calyx; or there are several florets contained in each calyculus. All the plants in this order are exotic herbs and undershrubs, the globe thistle being the most common in British gardens.

N. B. To the above five orders Linnæus added a sixth, called MONOGAMIA, in contradistinction to the other orders which are polygamous. The plants which stood in this sixth order were such as had their stamens united, as in the other orders of the class, but had simple flowers, not aggregated florets. The genus *Lobelia* was one, but which is, as well as all the others (except one) of the order *Monogamia*, now placed in the class *Pentandria Monogynia.*

The twentieth class is GYNANDRIA, containing all plants which have their stamens seated upon the pistillum. This class comprises one hundred and ten genera, and four hundred and thirty-seven species. The species are generally herbaceous, with tuberous roots, curious gouty, or climbing stems, many are epiphytes growing on trees, or flourishing in rotten vegetable matter in moist places. Some of their flowers are splendid, many highly fragrant, and all of remarkable conformation. The class is divided into three orders, viz.:—

Order one is MONANDRIA, containing plants which have one anther seated on the pistillum. This order comprises some of the most attractive wild British plants; as the orchis, ophrys, epipactis, &c. These, however beautiful, are excelled by those of the same tribe from America and other parts of the world.

The second order is DIANDRIA, flowers having two anthers seated on the pistillum. In this order we find one of the greatest British beauties, namely, the ladies' slipper, found in damp woods, and particularly in the north of England; but they never can be plentiful, because the moment the flowers appear they are gathered and torn up without mercy.

The third order is HEXANDRIA, containing plants which have six stamens seated on the pistil. This order has only one genus, namely, the *Aristolochia* or birthwort, a very curious family of climbing exotics; one only being found in Britain, viz., the *A. clematitis.*

Class Gyrandria.

The twenty-first class is MONŒCIA, consisting of plants which have male and female flowers separate, but on the same root. This class contains one hundred and forty-seven genera, and one thousand and fifty-two species. It may here be observed, that in syngenesious flowers the unisexual florets stand separately, but are included in the same cover; here they also are separate, but in distinct covers

This class is divided into ten orders, viz.—

Order one is MONANDRIA, that is separate male flowers bearing one stamen. Five genera are contained in this order, one of which is the celebrated bread fruit tree, a native of the South Sea Islands. The only British genus arranged here, is the *Zannichellia palustris,* the common pondweed.

Monœcia Monandria.

The second order is DIANDRIA, having distinct male flowers bearing two stamens. There are only four genera in this order, three of them exotic, and one British, namely, the common duckweed, the small floating plant which forms " the green-mantle of the standing pool."

Monœcia Diandria.

The third order is TRIANDRIA, consisting of plants, having separate male flowers bearing three stamens. Here are a few tropical trees, and a great many coarse European grass-like plants. The cat's-tail and bar-reed, are common aquatics, found in many parts of Britain. The maize or Indian corn also ranks in this order.

The fourth order is TETRANDRIA, includes all plants whose separate male flowers have four stamens. Here we find the alder and birch, forest trees; the box and mulberry trees; the common nettle, and the well known foreigner *Aucuba Japonica.*

The fifth order is PENTANDRIA, containing all monœcious plants whose male flowers bear five stamens. The amaranthus is most conspicuous here.

Monœcia Pentandria.

The sixth order is Hexandria, separate male flowers, furnished with six stamens. The plants of this order are chiefly palms, or allied to that tribe. The cocoa nut and sago palms are here, as well as the acrocomia and others.

The seventh order, Octandria, has separate male flowers, bearing eight stamens. This is a very small order, containing only one genus, the *Duvaua*, a lofty tree, indigenous to Chile. There are two species, one of them from *Owhyhee.*

The eighth order is Icosandria, containing plants which have male flowers separate, and bearing many stamens inserted into the calyx. Botanists have as yet discovered only one genus which can with propriety be placed here, and this a tree from New Holland, called *Atherosperma moschata.*

The ninth order is Polyandria, which contains plants whose male flowers are separate, and which bear many stamens, seated on the receptacle. This is a pretty large order, and comprises the beautiful *Begonia,* the chestnut, beech, hazel, walnut, and above all, the lordly oak. Here also we find the planetree, Salisburia, and humble yet numerous tribe of arums, &c.

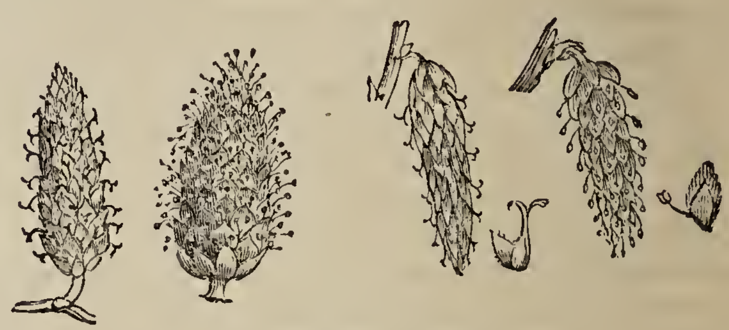
The tenth order is Monadelphia, that is, plants having male flowers distinct, and whose stamens are united at the base into one brotherhood. This is the largest order of the class, and contains some of the most magnificent forest trees, as the pines and firs, larch, cedar, cypress, &c. Here are also the enormous gourd, useful melon, and cucumber, the poisonous janipha manihot, and the medicinal palma Christi.

Monœcia Polyandria.

Monœcia Monadelphia.

The twenty-second class is Diœcia, which is composed of plants which have unisexual flowers, not on the same, but on different roots. In modern nomenclatures this class has arranged in it one hundred and three genera, and six hundred and sixty species. It is divided into no less than thirteen orders, which are as follow, viz.:—

The first order is Monandria, consisting of plants bearing unisexual flowers on different roots, those of the male plant having but one stamen. This is a small order, containing only two genera, one being the remarkable screw-pine; so called because the leaves resemble those of the pine apple, only much larger, and they issue from the stem in a very different manner; that is, neither opposite or alternately, but the last always a little to the left of the former, so that they are expanded spirally like the worm of a screw.



Diœcia Monandria.

The second order is Diandria, containing plants having unisexual flowers on different roots, the males bearing two stamens. This order contains four genera, of which the common willow is the principal; there being of this genus no less than one hundred and sixty-seven species already described. The *Valisneria spiralis,* so beautifully described by Dr. Darwin in his "loves of the plants," belongs to the order.

The third order is Triandria, having male flowers on one plant, and females on another, the former being furnished with three stamens in each. This order contains twelve genera, among which one is a common trailing plant, found on our moist moors—namely, the crow-berry. The date-bearing palm, so useful to the common people in Persia, and other countries where it grows naturally, also belongs to this order.

The fourth order, Tetrandria, consists of plants having flowers of one sex, but on distinct roots. The male plants have four stamens in each flower. This order contains fifteen genera, among them we find the candle-berry myrtle, one species of which is found wild in Britain, namely, the sweet gale. The parasite mistletoe is also common in England on oak trees, white-thorn, and particularly in apple orchards. It is said that the oaks on which mistletoe grew, were particularly valued by the Druids, and under them they performed their devotions.

Diœcea, Triandria and Tetrandria.

The fifth order is Pentandria, the male plants of which bear flowers having five stamens. This order contains thirteen genera: among which are the well-known culinary vegetable spinach, and the no less valuable hop. All the other genera are exotics. Respecting the hop, it has been said that it was formerly the custom to root out all the male plants from every hop-garden; but that now the custom is found erroneous; and one male plant to every twenty females is allowed by the growers, in order to give weight to the sample.

Diœcia Pentandria.

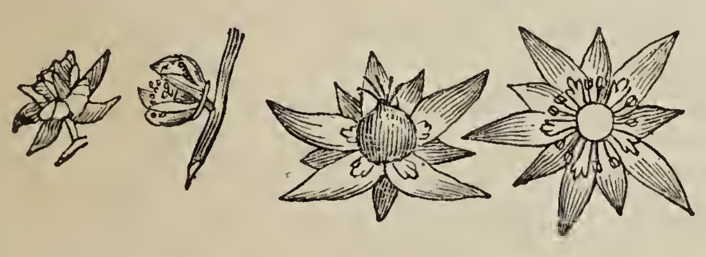
The sixth order is Hexandria, diœcious plants, bearing male flowers, having six stamens. This order comprises seventeen genera, among which are six palms, some of them of stately growth, and highly ornamental in their native countries. The genus *smilax* is also here, some of the species of which yield medical drugs. The only British genus is the black bryony.

Order seven is Octandria, containing diœcious plants, the males of which have flowers furnished with eight stamens. This is a very small order, containing only the genus poplar. Four species are natives of Britain, one of which, the white poplar, grows to a very large size when standing in its favourite soil, a moist peat earth.

The eighth order is Enneandria, the male plants of which bear flowers having nine stamens. This is also a small order, containing only three genera, two of which, the mercury and frog-bit, are British. The third triplaris is an American tree, useful for its timber.

Diœcia Octandria and Enneandria.

The ninth order is Decandria, the male plants of which have ten stamens. Another small order, containing five genera, all of which are exotics. One of the principal is the papaw, a large tree-like herb, bearing bunches of fruit resembling melons, much used in India.



Diœcia Decandria and Dodecandria.

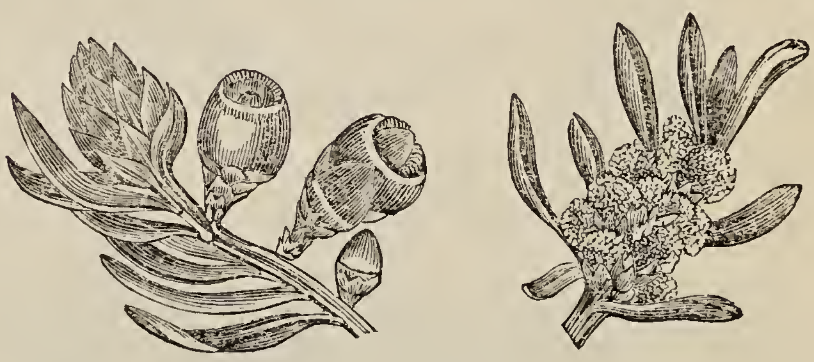
The tenth order is Dodecandria, the male plants of which are furnished with twelve stamens. This order contains six genera: among them we find only one British, an aquatic, called the water-soldier. Another is the menispermum or moon-seed, which, with all the others, are exotics.

The eleventh order of the class Diœcia is Icosandria, the male plants of which bear flowers having above twelve stamens inserted in the calyx. There are only three genera, none of which are British; in botanical collections they are inmates of the hot-house.

Diœcia Icosandria and Polyandria.

Order twelve is Polyandria, the male plants of which are furnished with many stamens, fixed on the receptacle. This order contains seven genera, all of which are exotics. Here we find *Cliffortia*, a genus common in our green-houses. Also *cycas* and *zamia*, plants of curious habit, to be met with in most collections.

The last order of the class is Monadelphia, the male plants of which bear flowers, in which the stamens are united in one brotherhood. This order comprises fifteen genera, of very various bulk and manner of growth. Here are the magnificent Bourbon palm, the lofty and symmetrical araucaria,—the humble butchers' broom—the pyramidal juniper—the dark yew—the fragrant nutmeg, and the curious pitcher plant, forming together a most interesting assemblage.



Diœcia Monadelphia.

The twenty-third class is Polygamia, signifying many marriages; that is, of plants having both

Polygamia Monœcia.

unisexual and bisexual flowers on the same, or on different roots. There is a good deal of uncertainty about placing plants in this division of the system, because some of the genera are not always constant in their modes of flowering; and even single plants will occasionally exhibit all the characters by which the different orders are founded.

This class contains sixty-eight genera, and seven hundred and thirty-six species, and is divided into two orders.

The first order is Monœcia, containing plants in which the polygamy is complete on one root, that is, where there are male flowers having stamens only, female flowers having pistils only, and flowers in which the stamens and pistils are united. This is a very extensive order, and contains many highly beautiful as well as useful plants. Here are the mimosas, the ingas, the acacias, the maples, the beautiful ailantus, and the fine fruit tree, the mango. There are also a good many of the gramineæ in this order.

The second order Diœcia contains plants which have the polygamy complete on two different roots. This order contains eighteen genera, among which there are the ash tree, so useful for its timber, the bread nut, the date plum, the anacardium, and the numerous family of the fig. Out of this last-mentioned genus Linnæus formed another order which he called Triœcia, having the polygamy complete on three distinct plants; that is, male flowers are found on one, female on another, and male and female flowers on a third; but as this circumstance has only been noticed on one species, viz. the cultivated fig, his followers have thought the order untenable, and it is therefore abolished.

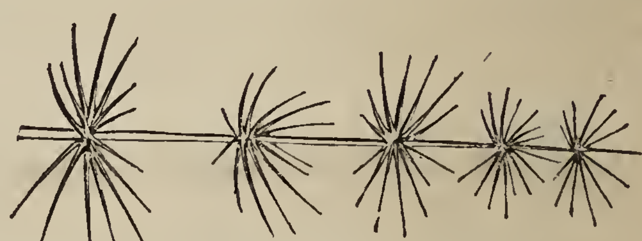
Polygamia Diœcia.

The twenty-fourth class is Cryptogamia, which signifies hidden marriages. This class is divided into nine orders, and contains three hundred and seventy-six genera, ,and two thousand six hundred and sixty-two species.

The first order is Filices, or ferns, having the sporule or seed conceptacles on the back of the fronds or leaves. These are a very curious and distinct tribe of vegetables. They have perennial roots, annually throwing up stems or fronds, which are evolved circinately; that is, the point of the frond, and its divisions, are rolled in upon their bases in their incipient state, and their develepement is an evolution or unrolling to complete expansion. In cold countries, the ferns are what the palms are between the tropics. their appearance being somewhat similar. Indeed, some of the ferns in South America vie with the palms in height, though not in duration; the former being much more fugitive. The fronds are kidney-shaped, linear, pinnate, or decompound; some are not more than an inch in height; others, in warm countries, arrive at many feet in height. According as the conceptacles, or spots whence the seeds or dust proceed are arranged on the frond, the generic characters are drawn; some, as the osmunda, have their fructification in a loose spike, quite different in form from the fronds. The habitat of ferns is on waste ground, damp rocks, or mossy stems of trees.

Filices.

The second order, Equistaceæ, contains only one genus, whence the name of the order is derived, namely equisetum, or horsetail, a common British plant found in pools and ditches. In some countries this plant is called frog-pipe, because they are found in the same situations. The horse tail is of most symmetrical growth; upright jointed stems, with verticillate fringes of linear leaves, bearing spikes of fructification on the summit.



Cryptogamia Equisetaceæ.

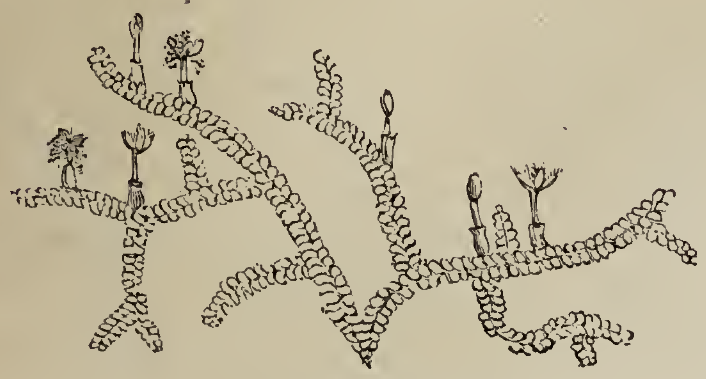
The third order is Lycopodeaceæ, containing only two genera. This is otherwise called club-moss, from the shape of the plants. This order of plants are found on peat bogs, and damp woods of peaty soil.

Cryptogamia Lycopodeaceæ.

The fourth order is Marsileaceæ, containing four genera. These are very inconspicuous plants, springing up on moist ground among moss or grass, having the appearance of tufts of small quills; others bear little round heads; hence they are called pillwort.

The fifth order is Musci, containing a great many genera and species. These flourish only in cold northern countries, and in shady damp situations. Bogs and moist ground are covered with them, forming a soft and compact carpet. They rank in the lowest order of vegetation, and serve for a protection or food for larger plants.

The sixth order is Hepaticæ, consisting of small creeping inconspicuous plants, having their leaves imbricated on each other, and quite distinct from the lichens, which they in some degree resemble. One of the genera, the jungermannia, is the most common, and met with on bogs, moist woods, and sides of mountains where springs ooze out.



Cryptogamia Hepaticæ.

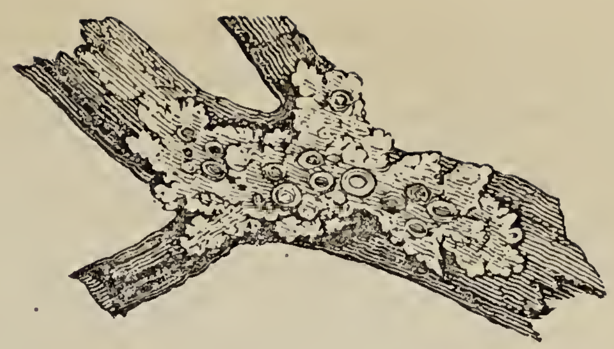
The seventh order is ALGÆ, containing seventy nine genera, which are chiefly aquatics inhabiting the sea, lakes, and rivers. In the second tribe of this order we find conferva, a numerous genus, and remarkable for its being sooner detected by its colour than its form. The green scum, which so soon appears on a glass of water, or on the surface of moist earth, or on the inside of water vessels, or on stones in brooks, is conferva of one species or other. The greater number of algæ inhabit the depths and shallows of the ocean, hence called sea-weeds.

Cryptogamia Algæ.

The eighth order is LICHENES, containing all those scaly, ash-coloured substances which grow on rocks, walls, buildings, or stems of trees. They assume very many forms; some are spread out in thin parchment like expansions, others rise from the surface on which they grow, and present shaggy tufts of a hoary appearance. Some of them are the food of animals,

Cryptogamia Lichenes.

as the reindeer of Lapland; others are medicinally useful, and a few are used by the dyer.



Cryptogamia Lichenes.

The ninth and last order is FUNGI, comprising all the mushroom tribes. There are above one hundred and fifty-nine genera, and upwards of one thousand one hundred and fifty-seven species already on the published lists; and no doubt many more exist undiscovered. The major part of the fungi grow on rotten wood, and other decayed vegetable and animal substances. Some of them are eatable, and much used in refined cookery, others poisonous, and much caution is requisite even in choosing those which are allowed to be wholesome. The dry rot in timber is said to be caused by different kinds of fungi.

Cryptogamia Fungi.

To these twenty-four classes the author of the sexual system added an appendix containing the order *Palmæ*, the flowers of which, in his time, were not sufficiently known to enable him to place them in the proper classes; this task, however, has been performed by modern botanists, who have distributed the palms among the different classes and orders according to the Linnæan rules, and where he himself would have placed them had he been acquainted with their manner of flowering.

The foregoing is an outline of the sexual system of botany. The annexed delineations of the numbers and dispositions of the sexual parts on which the system is founded, render longer descriptions of the classes and orders unnecessary. For by an attentive examination of the titles compared with the figures, as perfect a knowledge of the system may be acquired, as is necessary for any one seeking information on the subject.

For the easy classification of the various tribes of plants, the sexual system as is well calculated as any other artificial scheme that can be devised; and as a first step to gaining a knowledge of the different forms of flowers it is indispensable. But like all other artificial systems it has its defects; these are bringing together in the same class, plants which have neither resemblance or affinity with each other, save in the circumstance of their having the same number of stamens. Some of the true grasses for instance, are classed with genera having no kind of similitude or congeniality; indeed, many anomalies are found in the system, which show its artificial character, This, as before observed, was felt and acknowledged by the author himself, and has led to the new system of Jussieu, of which we now proceed to give as concise an account as is consistent with perspicuity.

The Jussieuian, or Natural System.

The author of this new system of botany seems to have taken a very comprehensive view of the vegetable kingdom, and has been fortunate in fixing on those greater characteristics of plants which distinguish them from each other, and which are the most invariable. Looking at vegetable membrane he found it was either uniformly simple, that is, consisting of tissues of cells of nearly equal size, or of tissues of which the cells were of various sizes intermixed with each other, and formed into fibres lying in straight or in spiral positions, and forming tubes and openings of different structure and consistence. This evident difference of structure served to divide the whole vegetable kingdom into two parts; the first he called *Cellulares*, the second *Vasculares*. He further observed, that all the plants of the first division sprung up destitute of seed leaves, (*cotyledons*), and those of the second division sprung up from the seed furnished with either one or two seed-leaves. This difference in the germination of the plants called vascular, served to separate this grand division into two very distinct classes, namely, Dicotyledoneæ, containing such plants as rise with two seed-leaves; and Monocotyledoneæ, those that rise with one. These classes are also very different in the manner of their growth; the first, *Dicotyledoneæ*, is increased annually by additions to the outside, hence called *Exogenes;* and the second, *Monocotyledoneæ*, receives additional matter from the inside, hence denominated *Indogenes.* Besides these very striking characteristics as regards the growth, the structure and appearance of their foliage is also obviously different. In a leaf of the first class the petiole is extended directly through the web, and as it proceeds, sends off branches towards the margin on both sides, whereas in a leaf of the second class there is no costa or mid-rib, the petiole being divided into several parts, which run in nearly parallel lines from the base to the apex of the leaf.

By these obvious distinctions in the manner of germination of the seeds, the modes of accretion, and in the structure of the stems and foliage, the two classes of dicotyledoneæ are clearly marked. But as there are great differences in the parts and positions of the floral members, the author of the system thought it expedient, in order to facilitate the study of it, to separate the first class into two subdivisions, and these again into sub-classes, as follow:—

The first grand division, Vasculares, of which the first class is *Dicotyledoneæ*, rising with two seed leaves. Of this class the first subdivision is *Dichlamydeæ*, that is, two coats or coverings, the calyx and corolla being distinct.

This subdivision is further divided into three sub-classes, viz., first, *Thalamifloræ*, containing flowers in which the stamens are seated under the pistillum.

This sub-class contains fifty-eight orders, all under proper titles derived from some one of the genera, which is assumed as the general type of the order. For instance, the first order is called *Ranunculaceæ*, because all the other orders of this sub-class resemble more or less in structure and form the flowers of the ranunculus, or crowfoot. Here we find associated the anemone, the peony, aconite, columbine, marsh-marigold, hepatica, adonis, &c., all of which show an affinity in their modes of flowering.

In applying this portion of botanical knowledge, the student has to ascertain whether the seedling rises with two seed-leaves, whether on seeing the flower it presents a calyx and corolla distinct from each other, and finds all the stamens seated below the germen—he may conclude that the plant belongs to this sub-class; and if not to the order *Ranunculaceæ* to some other allied order, with the character of which it may better agree in general habit, as to whether herb, shrub, or tree.

The second sub-class of this division is *Calycifloræ*, containing plants whose flowers have the stamens seated on the calyx.

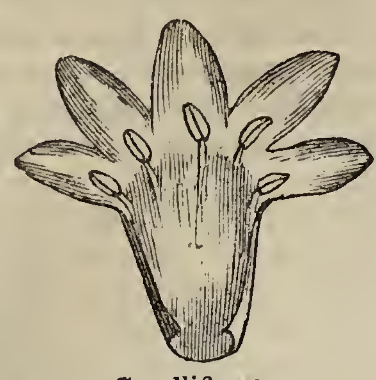
This sub-class comprises fifty-eight orders, one thousand one hundred and forty-nine genera, and eleven thousand four hundred and forty-five species. One of the most beautiful orders is the *Leguminosæ*, which contains all plants bearing pods and having butterfly-shaped flowers. So numerous indeed, and so varied are the genera in this single order that, it is divided into divisions, sub-orders, sub-divisions, tribes, and sub-tribes, in order that the numerous species composing it may be easier understood, and recognised. To the *Lejuminosæ* the order *Rosaceæ* is the next in importance. Its type, the common rose, is not more regarded for its beauty and scent, than are many of its associates for their excellent fruit.

Here we find the cherry, plum, apricot, and peach, the principal of our wall fruit of this country; besides many of our smaller fruit cultivated in gardens, as the gooseberry, currant, strawberry and raspberry. Nor should the fine serviceable fruits, the common apple and pear, be forgotten These also belong to this order; and for the use of the table, the kitchen, and for the manufacture of cider and perry, are inestimable.

The white thorn, with which our fields are divided from each other, and which enlivens with its snow-white blossoms the whole country during the month of May, also belongs to this order.

Besides the above, many other beautiful flowering plants are also placed here: indeed, all plants bearing rose-like flowers are put into this sub-class, as the myrtle, the Eugenia, the Barringtonia, together with those useful foreign fruits, the different species of guava. Here also we find the elegant passion-flower, and all those curious tribes of plants from foreign countries, the crassulas, mesembryanthemums, cactuses, cereuses, and the like. Here also is ranked the extensive European family of plants, the saxifrage or stonecrop, together with many other floral beauties, which it is unnecessary to mention.

The third sub-class of the natural system is *Corolliflorœ*, including all flowers which have the stamens attached to the corolla; the petals cohering in the form of a hypogynous (that is, seated below the germen) corolla, but separated from the calyx. This sub-class contains four hundred and eighty-five genera, and four thousand one hundred and ninety species. Among these the olive, as a useful fruit tree, and the jasmine for its beauty and fragrance, are well known. The *asclepias* is also here, and gives a title to one of the orders, and which order comprises many genera remarkable for the curious structure and colours of the flowers, and the uncommon rankness of their scent. The humble gentian, and the climbing bignonia and convolvulus, are also here; so is the order *Solaneœ*, which contains the wholesome potato and the poisonous night-shade; the intoxicating tobacco, and the pungent capsicum. The numerous order *Labiatœ*, is in this sub-class, containing so many of our useful aromatic herbs, as thyme, mint, balm, &c. Many floral beauties are also here: the order *Primulaceœ* embraces some of the most common, though at the same time most admired; namely, the primrose, cowslip, auricula, and anagallis or pimpernell.



Corolliflorœ.

The second subdivision is Monochlamydeæ, signifying two coats in one, the calyx and corolla being blended together; at least these members are not distinct. This subdivision contains twenty-seven orders, two hundred and fifty-six genera, and two thousand six hundred and twenty-eight species. Here are associated herbs, shrubs, and trees. Of the first the amaranthus and begonia are conspicuous: among the second the proteas and their alliances, the banksias, dryandras, and telopea stand pre-eminent; and among the trees the cinnamon, nutmeg, bread-fruit, and mulberry, are some of the most remarkable; and of forest trees, the whole orders *Coniferœ* and *Amentaceœ*, afford familiar examples.

Monochlamydeæ.

The second class of the natural system is Monocotyledoneæ, comprising all plants which rise from the seed, and exhibiting *one cotyledon* or seed-leaf only.

Monocotyledoneæ.

This class contains thirty-three orders, six hundred and thirty genera, and four thousand seven hundred and two species of beautiful, and, except the palms, herbaceous plants. Here we have all the bulbous and tuberous-stemmed flowering favourites, as the *Orchideœ*, *Irideœ*, *Tulipaceœ*, and *Amaryllideœ*, which include a great majority of our gayest bed, border, and green-house ornamental plants. The pine-apple, the plantain, and the various kinds of palms, all esteemed as yielding delicious fruit, are also here. Another order, perhaps the most useful of all, is ranked in this class, namely, the grasses, of which there are one hundred and fifty-eight genera found in different parts, but chiefly in the temperate regions of the earth. These furnish universal pasturage and provender for cattle; sugar, bread, and spirituous liquors for the use of man. Lower grades of plants are grouped with the grasses; as the careces and rushes, and most of the aquatic tribes.

The second grand division of the system is Cellulares, signifying plants composed of cellular tissue, and with but few instances of the existence of spiral vessels in their structure. They are reproduced by minute sporules discharged from their conceptacles, and rise from the earth without cotyledons or seed leaves: hence this division is also called *Acotyledoneœ*. It contains three hundred and seventy-six genera, and two thousand eight hundred and fifty-nine species, and which are divided into two classes.

The first class is Foliaceæ, containing such plants of the division as exhibit leaf-like expansions. Of this class there are six orders, viz:—

The first order is Filices, which contains all the different sorts of ferns. Of these there are fifty-three genera, and eight hundred and thirty-seven species, already described. Ferns have a perennial stem entirely under, or creeping on, the surface of the ground. The stems are increased in length and thickness by internal accretion, and by the persisting bases of former leaves. From the point of the stem, and from tubercles on the side, the fronds or leaves are produced, and in a peculiar manner; instead of simple elongation, the expansion takes place by evolution—the face of the leaves, and lateral divisions of the leaves, being unrolled from the bases to the points. Some of the ferns have simple leaves, and in many they are compound and much divided. In size these plants vary from a few inches to twenty feet in height.

The second order is Equisetaceæ, containing only one genus, and ten species. These are aquatics, and they grow on very damp clayey or loamy soils. Their forms are regularly elegant, though their foliage is very attenuated, and growing in whorls from the joints of the stem. The stems of most of the equisetums, or horse-tails, as they are provincially called, are succulent, erect, and regularly jointed; the reproductive organs being borne on a scaly kind of catkin at the apex of the stems.

The third order is Lycopodineæ, or club-moss. Of these there are two genera, and nineteen species, all herbaceous prostrate plants. Their leaves are simple, and lie imbricated over each other from the base upwards. They are usually found in damp woods and bogs, and they shed sporules like ferns.

The fourth order is Marsileaceæ, comprising four genera, and one species of each. They are simple leaved or floating plants, found in different parts of Europe. They are of no known use, nor are they met with in botanical collections.

The fifth order of this class is Musci, or mosses. Of these thirty genera, and three hundred and thirty species are described. They are a humble and common tribe, inhabiting cold damp places, and attaching themselves to rocks, stones, or moist buildings:

often growing among, and sometimes extirpating, the grasses of moist meadows.

The sixth order is Hepaticæ or liverwort moss, containing six genera, and ninety-four species. They are like some of the foregoing small creeping plants, and inhabiting the same damp and cold places. They are, however, very different in structure from the other genera of this class.

The second class of cellulares is called *Aphyllæ*, because they are entirely destitute of leaves or leaf-like expansions. This class has three divisions. The first is Algæ, containing seventy-nine genera, and four hundred and fifty-three species. Among the algæ the simplest forms of vegetation are to be found, and also some gigantic sea-weeds rising from great depths of the sea. Some of hair-like structure have a spontaneous motion like worms; some require a microscope to be seen, and of very different character as to duration, perennial, annual, or ephemeral. Some of the sea species are edible, their flavour being mild and rather grateful.

The second division are the Lichenes, containing thirty-five genera, and four hundred and twelve species. These are the plants which cause the weather-stains on old buildings; they creep on the naked rocks, and attach themselves to the trunks and branches of trees. Some of them are used in diet and in medicine, and several by the dyer. They flourish most in northern climates, and for some animals answer the purposes of forage.

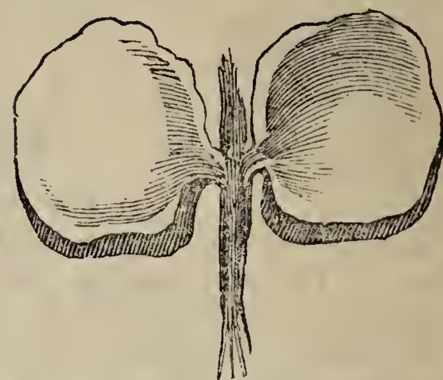
The third and last division of the class aphyllæ is the Fungi, which is by far the most numerous of all. Of these there are one hundred and fifty-nine genera, and one thousand one hundred and fifty-seven species. The mushroom is one of the best known genera, and lends its name to many that do not belong to the family. The toads' stool and other boleti are often mistaken for mushrooms by ignorant people, who not unfrequently use them at the peril of their lives. The mould on cheese and stale bread are fungi; so is the mildew on trees, and the rust on corn. Though so many of this division have been discovered, it is more than probable that hundreds remain unnoticed and unknown.

As the figures of the classes and orders of the second grand division Cellulares are all represented on the plate, they are omitted under their respective titles here, being easily referred to while the descriptions are read.

The foregoing is a very brief sketch of the Jussieuan system as improved by later writers. The descriptions of the divisions, classes, subdivisions, and subclasses, are all intentionally brief, because these, together with each order of the subclasses, have been or will be particularly noticed as they occur alphabetically in the body of this division of the Cyclopædia. Another reason for the brevity alluded to is the pictorial illustrations of Jussieu's divisions and subdivisions, which will be found at the end of this article, and which, when compared with the explanations of the titles of each subclass, cannot fail to convey a pretty clear idea of the grand features of this popular and nearly universally received system.

As there are many other terms employed in the Jussieuan system of botany that have not been used in the foregoing sketch, it may be necessary in this place, while giving a kind of summary of the whole, to notice them.

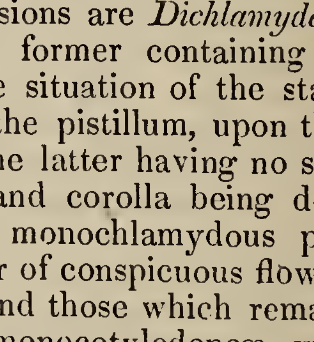
It has already been observed that Jussieu divides the vegetable kingdom into two grand and well defined parts, namely, Vasculares and Cellulares. The first is also called *Cotyledoneæ*, and the second is also called *Acotyledoneæ* for reasons assigned under those titles. Vasculares are, moreover, called *Phanerogamia* or *Phænogamia*, because they have visible flowers; and cellulares are called *Cryptogamia*, because they have no visible flowers.



Germination of Dicotyledons.

Vasculares are separated into two classes called *Dicotyledons* or *Exogenes*, and *Monocotyledons* or *Endogenes*, significant of their manner of growth; the former rising with two seed-leaves, and increasing by additions on the outside; the latter rising with one seed-leaf, and increasing by additions in the inside of their stems.

These greater features of the system being first fixed, the author next proceeded to determine what should be the signs for subclassing the vast number of plants then known to botanists. This subclassing was necessary on two accounts, viz., to follow nature in forming congenial groups, and to facilitate the study of the science. In doing this he was naturally led to the consideration of the structure of the flowers. Here he found that a very great majority had the two outer coats, namely, the calyx and corolla, perfectly distinct; and another considerable portion of flowers in which these members were united. This difference of structure afforded very obvious marks on which to found two subdivisions of the first class. These subdivisions are *Dichlamydeæ* and *Monochlamydeæ*. The former containing three subclasses founded on the situation of the stamens, as whether seated below the pistillum, upon the calyx, or upon the corolla; the latter having no subclass, the union of the calyx and corolla being deemed a sufficient distinction of monochlamydous plants. Thus the greater number of conspicuous flowering plants were disposed of; and those which remained, forming the second class monocotyledoneæ, were easily distinguishable by the circumstances of rising with one cotyledon only, and from the very different structure of their leaves and stems.



Dichlamydeæ; calyx and corolla distinct.

Thus were the phænogamous or flowering plants arranged; and it only remained to classify the cellulares or acotyledoneæ in some other way than by their flowers, which were unobvious or unknown.

This was accomplished by placing all that had leaves in one class called FOLIACEÆ, and all leafless cellulares in another which the author called APHYLLÆ.

That Jussieu has chosen for marks of distinction those particulars of structure and exterior conformation which are the least liable to variation is perfectly true; and perhaps no plan could be hit upon that would better distinguish the principal features of vegetation. This is so far well, because it enables the student to group plants with comparative ease, and which alone is a great advantage. At this point many amateur botanists may be disposed to stop, because in proceeding to be able to identify species, or even genera, is much more laborious, and requires a greater share of practical knowledge than Linnæan botany; and this very circumstance will probably keep the latter system longer in the schools than it would otherwise be.

BOTRYCERAS (Willdenow). An evergreen shrub from New Holland, resembling a laurel, and in the natural order *Proteaceæ*.

BOTTLE GOURD. Is the *Lagenaria vulgaris* of Seringe. This with several varieties obtained from it, are cultivated in the East Indies, their native habitat. They are annuals, and cultivated in this country for the curious form and colours of their fruit.

BOTTLE-TIT or LONG-TAILED TITMOUSE (*Vagans*, Leach; *Parus caudatus*, and *Longicaudatus*, auctorum). A very curious little bird, frequenting low wooded situations in all parts of Europe; very plentifully in Holland, and abundant and pretty generally distributed over Britain. It is a very small species, not exceeding in size and weight the common wren, but is much longer in the tail, and in structure nearly resembles some of the titmice (*Parus*), in which genus it has been commonly arranged.

The bill is black and very short, but appears more so in the adult bird, from its base being hidden in the feathers, which project forwards and conceal the nostrils, and are generally half erected on the head, of a more arcuated form than in the titmice, the upper mandible slightly curving over the under. Irides, in the adults, dark reddish hazel; bare skin around the eye, orange yellow; the forehead and crown of the head are white; from near the bill, passing over the eyes, are two streaks of black, which join at the nape of the neck, forming a broad streak which runs down the middle of the back; scapulars, which, in the birds that have moulted twice, form on each side a large broad spot, roseate; in the younger individuals there is less of this colour, and the spot is but ill defined. The quills black; secondaries deeply edged with a whitish colour. The under parts also are whitish, with a line of dusky spots across the breast, and are tinged about the flanks with rosy red. The tail is very long and wedge-shaped, except that the two middle feathers are shorter and sometimes narrower than the two next, which latter are, in the adult, longest of all, those on each side being successively shorter and shorter. Legs and toes blackish, rather more slender than in the titmice, with the claws very pointed and sharp, and the grasp of the foot amazingly strong.

The sexes in this bird are much alike, but the young in their first or nestling plumage are very different. In these the two mandibles of the bill are of equal length, black, excepting the tip of the upper, which is whitish, where, in about six weeks, it grows and curves over the under. The bill also appears considerably larger than in the old bird, from its base not being concealed in the plumage. The irides are at first dark greyish, like those of a young cuckoo; in the course of two or three weeks becoming much paler and brighter, and more inclining to blue; then gradually darkening, till in eight or ten weeks, they assimilate to the colour of the pupil, so as only to be distinguished when examined closely. The colour of the bare skin around the eye at first is brick red, afterwards becoming very bright and conspicuous about the time the irides are darkest, the upper part changing to orange-yellow in the autumn, the under not till late in the following spring. Crown of the head (a much larger portion of it than in the adult), together with the whole under parts and some of the lower scapulars, pure white, without a tinge of roseate, but appearing on the flanks greyish, or intermixed with black, the feathers of these parts being thin and puffy, and showing much of their blackish inner portions. Ear-coverts, which in the adults are whitish with a few dusky spots, black; line over the eye and the whole upper parts also black, the few white scapulars forming merely a narrow white line. The wings and tail marked as in the adult, but more indistinctly, the black being everywhere more dusky than in the old bird.

Bottle-tit.

The tail also of the young bottle-tit in its nestling plumage is considerably longer than that of the adult, the two feathers next the middle measuring three inches seven-tenths; those next again measuring about a tenth more; the middle ones wanting a tenth of three inches, being a mere trifle longer than the fifth. In the adult bird the proportions are, middle feathers the same as in the young; the two next, which are longest, only one-fifth of an inch more, the longest feather being thus seven tenths shorter than in the young; a difference which, however slight it may appear, is very striking when the two birds are seen together.

The above detailed descriptions are taken from a considerable number of specimens, amongst which there is no variation, at least beyond that already adverted to as resulting from disparity of age; and we have been thus particular in noting down all the minutiæ, having some reason to apprehend, from the descriptions of various authors, that two or three species, inhabiting different parts of Europe, are at present confounded together.

In describing the smaller feathered inhabitants of Britain, we have perhaps, in several instances, been rather more minute than the subject would altogether seem to require; but our object in being so has been to render the different species at once recognisable to all who wish to distinguish them in the fields. The study of birds offers peculiar advantages to those who have but little time for these pursuits. Quadrupeds, in a state of nature, are for the most part wild and wary, ever anxious to elude the eye of man; concealed during the day in holes and coverts, and in most instances coming out only by night when darkness veils them from our most vigilant research, they frequently defy the observation of the naturalist. In like manner are the inhabitants of the waters in great measure concealed by the medium in which they live, and insects are often hidden from us by their minuteness. Birds alone are ever before us; secure in their power of rising buoyant into the air, they move in confidence around, their beauty and familiarity pleasing the eye, whilst their melody, or even their most dissonant and harsh cries, from associations connected with them, delight the ear. And who is there that seeing does not admire these beautiful creatures, and that admiring does not feel a wish to become better acquainted with them? Moreover, there is a pleasure in verifying from our own observations the various accounts which we meet with in books; and nought is more likely to interest a young observer, and to incite him to fresh researches, than the qualification he feels in being able to judge from his own experience of the accuracy of at least a part of what is laid before him; he will endeavour, so far as is within his power, to assure himself by observation of the remainder, having already perhaps been often led astray by some of the erroneous compilations so much about; and in the course of his investigations will, not at all improbably, discover something worthy of notice that had previously escaped the attention of observers. Again, the meeting with a full description of objects which are continually within the range of our own observation not unfrequently awakens, in some minds, an interest about those objects which was entirely unfelt before; strange as it may seem, many persons seem to regard all common objects of natural history with feelings of great indifference, not to say contempt; and yet, from these very persons, we have often obtained much curious and interesting information respecting the habits of singular or uncommon species; information which our own subsequent researches have, in some instances, enabled us to verify and extend. Indeed it is not by any means unusual to meet with persons, collectors perhaps and preservers of the more curious British animals, who have a considerable acquaintance with the haunts and habits of many of our rare and less known species, but who are nevertheless absolutely ignorant of almost all that concerns many which are much commoner, though at the same time perhaps not so conspicuous. To these commoner animals we would wish to direct attention; their habits are often very interesting, and the study of them is alike accessible to all, yet they are not unfrequently still involved in much greater obscurity than many which but seldom come within the sphere of our observation; and this, from the comparatively little attention which has hitherto been bestowed upon them. We are not aware that the various peculiarities of the bottle-tit or long-tailed titmouse, the subject of the present article, have ever yet been pointed out, nor the distinctive peculiarities in which it differs from all the other members of the genus, in which it has usually been arranged.

There are few but must have observed sometimes, during the autumn and winter, a number of very small birds with long tails, following each other along the hedges, or from tree to tree, in a little troop, yet busily engaged the while in searching every twig and tuft of buds for insect food, hanging often with their backs downwards, and assuming every possible variety of curious and constrained attitude. "It seems," says an elegant and pleasing writer, Mr. Knapp, "the most restless of little creatures, and is all day long in a state of progression from tree to tree, from hedge to hedge, jerking through the air with its long tail like a ball of feathers, or threading the branches of a tree, several following each other in a little stream; the leading bird uttering a shrill cry of *twitter, twitter*, and away they all scuttle to be first, stop for a second, and then are away again, observing the same order and precipitation the whole day long. The space travelled by these diminutive creatures, in the course of their progresses from the first move till the evening roost, must be considerable; yet, by their constant alacrity and animation, they appear fully equal to their daily task."

This little bird subsists entirely upon the smallest insects in different stages of their growth; in this differing from the true titmice, as we would limit that genus, the different species of which (see Titmouse) are about the most omnivorous of little birds, and feed not only on insects, fruit, various kinds of grain, and even carrion, but sometimes also on such young and sickly birds as they can master, a fact of which the writer of this article has been more than once an eye-witness in different species. But the bottle-tit at no season touches aught but insect food, nor to obtain this does it ever, like the *Pari*, purposely approach our habitations, but keeps to hedges and thickets throughout the year. We have had occasion to examine numbers of them at all seasons, and in winter have almost invariably found in them the remains of a small species of beetle with pale brown elytra, but which we cannot exactly specificate from its being always so imperfect. It has, in common with the pari, the habit in winter of sometimes pulling off the buds of trees; but as stated in our account of the blue titmouse, we are very doubtful whether this is ever done but where the traces of insect food are discernible.

The tits, as we have already had occasion to observe (see Blue Titmouse and Bearded Reed Bird), are remarkable for their jay-like habit of constantly holding their food with the foot, or with both feet, whilst they pick it to pieces with the bill; but the bottle-tit at no time holds its food in this manner, nor has it the slightest notion of so doing. On giving one in confinement a large spider's nest, it was evidently at a loss to know how to pull out the eggs, tried to nibble out a small portion, and lay the remainder beside it on a perch, but was unsuccessful, and on returning to look at it after a few minutes' absence, it was found still carrying it about in its bill; but, on fastening it to a perch, it was demolished in an instant. Its strong muscular neck seems peculiarly adapted for pulling any thing upward by force, and it is thus that, in a state of nature, its food is mostly obtained.

In a recent publication*, after describing the minute insects on which the bottle-tit appears chiefly to subsist, some highly interesting remarks are introduced, on the relative degree of acuteness of vision in this and other species; from which it would appear that, in all probability, the sight of the bottle-tit is more peculiarly adapted for distinguishing very minute objects, than that of any other bird whatever. "It is probable," observes the writer, "that though this bird is a little larger than the gold-crested wren," the smallest of British birds, "it feeds on smaller prey. From the centre of the eyes to the tip of the bill is only four-tenths of an inch, while that in the golden-crested wren is one half more, or six-tenths. Hence it is probable that, in its vision, the long-tailed tit is the most microscopic of birds. Now it accords with analogy and with observation, as far as that can be carried, that the shortest focal length of the eye, that at which minute objects can be distinctly seen, is never much longer (if longer at all) than the distance from the eye to the tip of the bill; and nearer than that would be useless.

"Hence we have a very easy means of judging of the relative power of vision in those birds which feed upon very small substances, and which, being," at least comparatively, "hard billed, as the tits are, or not having the bill covered with a sentient membrane, or the nasal groove continued to the point of it, as is the case with that most singular of all birds the apteryx, or wingless bird of New Zealand, must feed wholly or chiefly by sight.

"In the average of human eyes, of good formation, and in a healthy state, the common focal distance for small objects, such as for reading very small print, is about seven inches and a half; and the microscopic distance, such as that at which a very delicate engraving is examined (and that requires a little time for the adjustment of the eye), is about one-third less, or five inches. The bird must often strike its prey without any time for adjustment, and therefore the distance from the eye to the bill may be taken as the ordinary short focal length; but call it microscopic, and the magnifying power in line being inversely as the focal length, the lineal dimensions of an object seen by the long-tailed tit will be to that of the same seen by the human eye, as five inches to four-tenths of an inch, or as twelve and a half to one. The surface will of course be as the square, or as $156\frac{1}{4}$ to 1, and the body or solid of an object, as the cube, or $1953\frac{1}{8}$ to 1. Thus an aphis or any other small insect that can come wholly within the field of vision, will appear very nearly as large to the long-tailed tit as *two thousand* of the same would to the human eye.

..... "The microscopic power of the eyes of those little birds which seek for minute prey on the bark of trees is, therefore," (the same author afterward continues, and we cannot do better than quote his observations,) "as wonderful as the telescopic range of the eyes of eagles and other birds which soar aloft, and scan a horizon of miles; and not the least wonderful part of the whole matter is the ease with which the eye changes from telescope to microscope. The eye of the eagle which can discern the motion of a small quadruped at the distance of more than a mile, can shorten its focus, so as to be keen and perfect at the distance of a few inches; and the tit, to whose near vision the eggs of flies must appear as large as musket bullets do to us, feels no difficulty at seeing a bush at the distance of more than a hundred yards. We may admire, but we cannot imitate that wonderful mechanical skill which can, in an organ not altogether larger than a pepper-corn, produce so many focal lengths in the same crystalline lens, instantly adapt the retina, or sentient tissue, to all of them, manage the admission of the proper light by the iris, and remove the colours and correct the aberrations by the other humours; all, as it were, in an instant, without effort, and (to use the common though unphilosophical terms) without *will* or *consciousness* on the part of the owner......

..... "Eyes have no doubt a wonderful flexibility in their focal length, so that the same eye is to a considerable extent both a telescope and a microscope. But still their flexibility or power of adaptation in that way has a limit; and as the focal length of the long-tailed tit's eye is not more than a twelfth that of the human eye, we may suppose that it cannot see so well at the distance of half a mile as man does at the distance of twelve miles."

Still, probable however as this last supposition may be in the case of the bottle-tit, the gold-crests, and a few other species, it certainly will not apply alike to the generality of small birds. The power of telescopic vision in most birds, even the smaller kinds, is very much greater than most naturalists seem to be aware of; and in this class of animals generally, as is indicated by the very flattened form of the crystalline lens, and as might perhaps be anticipated from the comparatively very large size of the eye, in proportion to that of the head, appears very greatly to exceed what it is in any other class. The great extent also to which diurnal birds can alter the apparent size of the retina, and consequently regulate the degree of light admitted into the eye, is very worthy of attention; and this may be easily observed by holding in the hand a whitethroat, or some other small species with pale irides, for it is curious that, when struggling to make their escape, they keep continually dilating and contracting the iris, often to its utmost; and after witnessing the extent to which they do this, we can no longer feel surprise that the eyes of diurnal birds are never dazzled by intense light. The eagle has been always famed for gazing with undazzled vision full at the sun, but she does this in common with every little bird; the sparrow, or the robin, or the common fowl, can face the sun as well as he; and this not, as is the commonly received opinion, by shielding the eye with the nictitating membrane, but simply by contracting the pupil, as any one, who will take the trouble to observe a common fowl, will readily perceive. With regard to distant or telescopic vision, the power of sight in most (even of the smaller) birds is far superior to that of most of the human race. The writer of this article has, in his garden, a number of small birds in confinement of various genera, and the whole of these he has

* "Feathered Tribes of the British Islands," by Robert Mudie. Article Long-tailed Tit.

repeatedly seen suddenly to cease from hopping about, and all gaze earnestly at some object in the sky; yet he has often strained his eyes in vain, and so have others that have been with him, and for many minutes, before they could just discriminate the minute speck which had so long riveted the attention of the birds; frequently, indeed, he has been unable to distinguish any thing, although to them a bird of prey was plainly perceptible, as the nature of their cries evinced. Other similar instances might here be added of this wonderfully acute vision of the feathered race in general, but it would too much extend the present digression. Of this, however, we are fully convinced, from repeated observation, that, piercing as the eye of a hawk may be, the majority of little birds see nearly, if not quite, as keenly from below; perhaps quite as much so in proportion, although they want the projecting super-orbital bone and attached muscular apparatus of the falcon family, an apparatus which is said to compress the eye and adapt it peculiarly for telescopic vision. (The osprey, by the way, however, one of the keenest sighted of this very family, is also without this projecting bone.) Indeed it is very well known that the common fowl, or the turkey, perceives the kite when far above the reach of human ken; and we think it will be found that this exquisite acuteness of vision is common to very nearly all the feathered tribes. The hawks, it may be remarked, which prey most on small birds, are those which come upon them unawares; of the high-flying species, the hobby attacks chiefly the lark, as it perceives it mounting to the sky; the kestril drops almost wholly upon mice; and the merlin (at least in winter in the cultivated districts, where only the writer of this has seen it) skims swiftly along the hedges, turns a corner, and comes suddenly on a flock of larks or finches, which, crouching or flying terrified in all directions, he singles out his victim, strikes it, and is gone in an instant.

Birds whose habits lead them to the open fields would be continually exposed to danger, were they not thus enabled by quick and powerful vision to guard against enemies from above; and those enemies would have no occasion for their extraordinary powers of enduring hunger and fatigue, and would multiply to the extirpation of their prey, if the constant vigilance of the latter did not prompt them to flee instantly to shelter, or to crouch and lay motionless like a portion of the surface, (the colour of which they always resemble, each species that of its appropriate haunt,) whenever the dreaded figure of a bird of prey first dimly presented itself hovering in the blue distance. It is even questionable whether the attention of predacious birds which seek their prey upon the ground is ever excited, but by perceiving some object to be in motion; and it is also extremely probable that, in every instance, the prey is first singled out when unawares. There are a considerable number of small land birds, however, which possess in very great perfection the faculty of distinguishing minute objects at an immense distance, but in which the immediate purpose of this faculty is not altogether so apparent; we allude to the mass of thrushes and warblers, which (from observations made on them in confinement) appear even to excel the ground birds in the promptitude with which they discover a distant foe. Now these are mostly the inhabitants of trees and bushes, amid the intricacies of which they can almost always effectually shelter themselves from the attacks of enemies from above; and the majority of them are never, like the fly-catchers, in the habit of watching the distant flight of insects through the air. Possibly, however, their powerful and acute vision may be of great and constant use toward finding their food, by distinguishing small caterpillars and various insects crawling among the foliage of a distant bough, and so enabling them to come at once upon their prey, which otherwise might be long sought for with little success.

But there are still certain other groups of species, the eyes of which are very full and convex, and which are consequently particularly adapted for very close or microscopic vision; and many of these, especially the gold-crest, evidently do not very clearly distinguish a large object, such as a human form, except it is in motion, when only they appear to evince alarm at its proximity. These are either bark birds, which creep about and subsist on the various insects which at all seasons lurk about the boles and larger branches of trees, or they are diminutive and hardy kinds, which examine the smaller twigs and sprays, and by constant exertion contrive to reap, both in winter and summer, an abundant harvest of small insects and larvæ, and of minute insect eggs which are deposited in such situations. These latter birds are the titmice and allied genera, which, brought together under the general term *Parinæ*, named from *Parus*, the typical genus, or that in which the more characteristic peculiarities of the group are most observable, form another of the marked leading divisions into which the *Sylviadæ* or great warbler family is divisible*.

The species of this division are mostly of diminutive size, but are generally of compact, short, well knit forms, and so warmly clothed with a dense covering of long puffy feathers (the webs of which are loose and discomposed), that they seem to bid defiance to all the rigours of winter. They are all of very social habits, except in the breeding season, and in several of the species the young follow their parents till the influence of that season prompts them to separate into pairs, at which time they are violently pugnacious. They nestle in the holes of trees or buildings, which are well lined, or they construct with wonderful art large and beautiful domed nests, which are warmly lined with a profusion of vegetable down, or soft feathers: a considerable degree of warmth seems here indispensable; and these hardy little residents, which brave the severest winters of our climate, prepare much warmer receptacles for their young than the mass of our small migrating summer visitants; but their broods are more numerous, eight or ten being about the usual average, and some species (as the subject of the present article) will sometimes lay as many as fourteen or even sixteen eggs, though twelve is a more common number: these, however, breed but once in the season. It would appear, therefore, that the heat generated by so small a body is insufficient to incubate so many, unless it be retained within a fabric of the most non-conducting materials; yet still it is by no means unusual to meet with one or more addled eggs in the nests of these birds, which appear to have sunk below the others into the downy yielding substance with which they are lined, and so to have been beyond the influence of the necessary heat generated by the sitting bird. We have particularly observed this in the nests of the bottle-tit and gold-

* For another of these divisions, the *Saxicoline*, or wheatear and robin group, see the article Blue-bird. These groups are hardly as yet sufficiently established to be placed in alphabetical order in the body of this work.

crest. The eggs of these birds are mostly white and semi-translucent, and are commonly more or less spotted with reddish-brown; and the young, in their first plumage, in general nearly resemble the mature birds, but are not so bright, and are never mottled or spotted. Their notes, which are often repeated and somewhat peculiar, are very characteristic, and have a considerable resemblance in all the species; and their songs (in the few instances which deserve the name) are short and monotonous. They seem fearless and familiar in their habits, though this may partly arise, in some instances (as in the gold-crests), from the decided indistinctness with which they appear to perceive large objects, and in others (as in the true *Pari*), more from the all-engrossing eagerness with which they seek their food, and in others again, perhaps, from both of these causes in conjunction. It does not, however, invariably follow that those species, the vision of which, according to the rule above laid down, would appear to be most microscopic, are also, in consequence of this, the least able to perceive small objects at a distance; for we have ascertained, by direct and careful experiments with these birds in confinement, that the bottle-tit can perceive a fly held to it at more than twice the distance that the gold-crest can; and that the blue and cole titmice can thus distinguish a small object clearly, very much farther than the bottle-tit. We have even varied these experiments several different ways, and have invariably obtained the same results.

As in most other *Sylviadæ*, small insects form the principal food of the *Parinæ*, but the members of the typical genus, *Parus* (see Titmouse), as before observed, are very omnivorous in their diet; and many species of this genus display the remarkable instinct of hoarding up stores of food in holes and other places, to which they resort in times of necessity. This has also been stated of the nuthatches (*Sitta*), a genus belonging to another family, but which is somewhat allied to the true titmice; but the statement has been always received with much doubt, and it has even been said, that the hoards of dormice, and other small mammalia, have been mistaken for the stores of these birds. M. Bechstein, however, who appears to have amused himself by keeping some nuthatches in captivity, expressly says, that "if these birds are left at liberty in the room, they are accustomed, like the tits, to hide the greater part of what is given them, to keep it for another meal;" and afterwards, speaking of the attractive qualities of the nuthatch in confinement, observes, that "its plumage, liveliness, agility, and great cunning in catching and hiding its food, are its most agreeable qualities." In this we see the utility, in studying the habits of animals, but especially birds, of keeping them for a time in captivity; of course, a natural history deduced only from such a source, would be a very meagre production indeed; but many curious and interesting peculiarities of various species, are only thus to be observed, which often throw considerable light on their wild habits; and besides, the very accurate acquaintance with their various notes and songs, which is thus easily obtained, is a very great assistance to the naturalist in his out-door researches, by enabling him, without difficulty, to recognise at once the different species even before they make their appearance. In the present case, we question much whether this habit of birds storing up their food, would ever have been noticed at all, had it not been observed in some that were in a state of confinement: it is a habit common to very many omnivorous species, and (as far as the observation of the writer of this goes) is peculiar to those which are omnivorous; consequently, though very observable in the cole and marsh titmice (*Parus ater* and *P. palustris*), which subsist on various kinds of food, we look for it in vain in the bottle-tit, and other species which are wholly insectivorous.

Few birds are so preeminently distinguished for the very beautiful structure of their nests, as the little bottle-tit is; and the nest of this species forms, without exception, the most exquisite fabric of the kind which is found in the British islands: several weeks are occupied in its construction, and yet it is often finished by the close of the month of March, or beginning of April; but in this case, as can be shown pretty clearly, it is never the production of birds of the preceding year. Bottletits, we know, remain in families till the return of spring; and an individual of this species is never seen, as the titmice often are, solitary, excepting when it has a nest to provide for. Now, it invariably obtains, among birds, that the older individuals are the first to feel the influence of the vernal season; and consequently, the old bottle-tits are found to pair, and leave their progeny, some weeks before the latter cease to be gregarious: and have thus often concluded the laborious work of nidification before the younger ones commence. This is not mere theory, for, as the bottletit that has twice moulted is very easily distinguishable from a younger individual by its superior beauty, we have been enabled to ascertain the fact, by shooting a few detached pairs in early spring, whilst the younger birds were still in society: and it therefore follows, as an almost necessary consequence from this fact, that when the bottle-tit pairs, it pairs for life; that is, the same pair remaining always together, and in company with their offspring till the following spring, invariably feel, some time before their progeny, the genial influence of the season, and they consequently then separate from their families of the preceding year, and again commence together the business of nidification. It is true that, during the winter months, three or four families of these birds sometimes seem to unite, and to follow in each other's train, thus forming an almost endlessly long succession of them from tree to tree; yet, each family at night appears to separate again from the others, and to retire to its own particular resting place.

Even here we may perceive a difference in habit between the bottle-tit and the true titmice: the latter invariably go to roost in holes; and so marked is this habit, that a marsh titmouse (*Parus palustris*), which we long kept in confinement, used for many months always to pass the night in a tin seed pan attached to the cage, as inconvenient a couch to all appearance as can well be imagined: but the bottle-tit always retires at night to the horizontal branch of some thick evergreen, a holly or spruce fir, where the family roost together in a line; and an amusing sight it is to see them settle, to see the family arrive straggling to the spot, chirrupping forth as they approach their peculiar *twittr*, *twittr;* but changing this note as they alight, one after another, to a low, scarcely audible soft *twittr*. They are a long time, however, composing themselves to rest, for, like numerous young *Sylviadæ*, the two on the outside keep continually flying up and working their way into the centre, and then the two next succeed and do the same, and so they continue till it is almost dark, twittering their soft note all the time, till on a sudden all is quiet.

To return, however, to the nest. It is of an oval form, and about the size of a large pine-apple, with a very small opening on one side near the top. Most writers have described it to have two openings, which is erroneous; and the great number of works into which this statement has found its way, shows how very much authors have been in the habit of copying from one another. It has even been said that the two holes serve for ingress and egress, and that when the bird is sitting, its long tail may always be seen projecting through one of the orifices. This no doubt is very fanciful and pretty, and answers extremely well to fill out and embellish the natural history of the bird; but as it certainly is not founded on fact, it only serves, like many other such careless statements about trifling matters, when found to be incorrect, to cast a doubt upon more important assertions; and when a work is found to contain many little similar inaccuracies, it never can be looked up to as an authority; as it is from trifles that we are accustomed to judge of matters of graver import. The fact is, that so far from this bird taking care of its fine tail, the very reverse is the case; which is perhaps the reason that the singular form of its tail has so escaped the observation of naturalists. Search when you may, it is rather a difficult matter to procure a bottle-tit with a perfect tail, and even immediately after the autumnal moult, many will be found with some new tail feathers injured, before others are properly developed; and at nesting time particularly, the tails of both male and female are invariably much curled and crumpled, and rarely more than half their proper length; which would perhaps imply, that both sexes perform by turns the office of incubation. So many respectable naturalists, however, have described the nest of this bird to have two apertures, that it is only after careful inspection of several dozens of them, that we here venture positively to assert that this never is the case.

An accurate and minute description of it, however, is given by Aldrovand, of which the following is a quaint translation:—"It was of an oblong figure, like a pine-apple; of two palms length, and one broad; round, built of sundry materials; namely, both tree and earth moss, caterpillars' webs, and other woolly-like matter and fibres, arranged with that order and art, that the chief and middle strength of the work, or texture of the walls, was of that yellowish-green moss, the common hairy moss, that silk-like substance, and tough threads, resembling those filaments suspended in the air, and flying up and down like spiders' webs, which are accounted signs of fair weather; connected and interwoven, or rather entangled so firmly together, that they could hardly be plucked asunder. Of the interior capacity, all the sides, it seemed, as well as the bottom, were covered and lined with feathers, for the more soft and warm lying of the young. The utmost superficies round about was fenced and strengthened with fragments of that leafy moss which every where grows on trees, firmly bound together. On the fore part, respecting the sun-rise" (which latter, however, is purely fortuitous), "and that above (where an arched roof, of the same uniform matter and texture with the sides and bottom, covered the nest), was seen a little hole, scarce big enough, one would think, to admit the old one."

This singular and curious fabric, the interest of which is doubly excited, when we contemplate the little bill which is the only instrument employed in its construction, is generally situate on the forked branch of an evergreen, about eight or ten feet from the ground; sometimes, however, in a large hawthorn bush; and we have more than once seen it beautifully placed amid the thickly blossomed twigs of a wild crab. The eggs average about ten or twelve, rarely less, but sometimes more; are of a semi-transparent white, and generally with a few small rusty-coloured spots, at the larger end; they are subject, however, to considerable variations; and they require about twelve days to hatch.

The bottle-tit is almost destitute of song; but in the spring months it utters, in addition to its usual chirrup, a very pleasing soft ringing note, very similar to the vernal call of the blue titmouse. At other times, it has no other call but that which we have here already endeavoured to express in writing, and which, serving to keep the family together, is continually repeated by them as they flit among the trees and bushes.

Being desirous of observing the habits of these curious little birds in confinement, we once procured a nest containing ten young ones, which were all easily reared upon chopped meat and egg, and very soon learned to feed of themselves. They became in a short time extremely quarrelsome, and fought with each other most cruelly; being very active, and so many together, one would sometimes fly up against another, and nearly overturn it, on which the latter would always attack whichever happened to be nearest, seizing it by the bare skin around the eye, and in an instant each would have its claws on the other's head, and both would fall together to the ground; here they would lie struggling for many minutes, uttering all the time a shrill twitter, and clinging so tightly that it was no very easy matter to separate them; after trying in vain to part them without tearing them to pieces, we have even tossed them from one end of a room to another without their ceasing to fight. Sometimes three, or even four, would thus lie entangled together on the ground, and yet, strange to say, they never seemed to hurt each other much. The chief point of attack was always the bare skin around the eye.

This quarrelsome propensity may be observed in most young birds, its obvious purpose being, seemingly, to promote their dispersion; at least, so one would imagine. Yet this explanation of it cannot exactly apply to the bottle-tit, as the families keep together till the following spring. It certainly was not want of space that caused it, for they were in a very large cage, and even when loose about the room it was just the same; without any apparent cause, one would often follow another and attack it. It lasted, however, only about ten days, or a fortnight, and afterwards they lived together very peaceably. We have often observed similar and equally violent combats among these birds in the spring, about the time when the young of the preceding year are pairing.

The power which the bottle-tit has of grasping with the feet, is very considerable, fully equal in proportion to that of a woodpecker; and when the individuals we are now describing were young and playful, it was no uncommon sight to see one clinging (sometimes by one leg) to the long tail of another, and not to be easily shaken off. They seemed to bathe less frequently than the different titmice, but were extremely fond of sunning themselves; that is, of extending themselves towards the sun, with neck stretched out, every feather erect, and tail and sunward wing spread wide. An observer, unaccustomed to the sight, would fancy they were dying, or that something very bad was the matter: this is a habit common to many of the *Sylviadæ*.

When they became fully able to take care of themselves, they were turned into a large cage, containing various other birds of this family; and here they unexpectedly found a protector. A tree pipit (*Anthus arboreus*), which had long been in confinement, fed and tended them with all the care of a parent. They had for some weeks picked up their own food, but still had no objection to be fed; and it was often an interesting sight to see the pipit (so incongruous a species), with food in his mouth, looking up earnestly at the active young bottletits, and waiting patiently till one of them could find leisure to come and take it.

This interesting little family had thriven so well, that we began to fancy we should be overstocked with them. Some were given away, and soon after one of them died of obesity; then another, and another, till the stock was at length reduced to four: this number continued for some time, till one morning, without any apparent cause, three of them were found lying dead. The sole remaining one survived the others two or three months, and at length died when it had nearly finished moulting. It is worthy of remark, that this individual would hardly ever touch meat, of which all the others were very fond; and to this, we think, may be attributed its comparative longevity. It fed principally on bread and milk, and upon crumbled bun and bruised hemp-seed; would sometimes just taste a little fruit, but did not eat it like the true titmice; and it was at all times very active and lively, and out of its cage troublesomely tame.

The writer of this has described the habits of these birds in confinement somewhat in detail, as he is not aware of any previous instance of their being kept in a cage; nor, as the birds which are captured old will never live, are there many who will take the trouble to keep them, as they must necessarily be reared from the nest. It is only thus, however, that the writer has been able to satisfy himself that this species should be arranged separately from *Parus*, though previous observation of it in its wild haunts had long led to the supposition. Now, however, he is fully convinced, from a due consideration of the many peculiarities of its structure, manners, habits, food, the character of its plumage, and various other minor particulars, that it cannot properly range in the same minimum division with the true titmice, and that consequently Dr. Leach was perfectly right, in removing this very singular species from the genus *Parus*, and forming of it a separate division.

BOTYS (Latreille). A genus of lepidopterous insects belonging to the nocturnal division of moths, and to the family *Pyralidæ*. The body is long and slender, the antennæ short and simple in both sexes. The wings form a triangle when shut, the tongue is very apparent and serves for the ordinary purposes of a tubular haustellum. The larvæ are naked, with sixteen legs, and the pupa is inclosed in a cocoon of silk spun within a rolled up leaf. The type of the genus is the *Pyralis urticata* of Linnæus, a pretty and common British species, known to collectors by the name of the small magpie moth. The thorax and tip of the body are yellow, the wings white with bands of black spots. The larva resides in folds of the leaves of the nettle, bindweed, &c. It remains nine months in the cocoon previous to assuming the pupa state.

BOURBON PALM. Is the *Latania borbonica* of Commelin. This fine ornamental palm belongs to *Diœcia Monadelphia* of the sexual system, and to its own order of course. Generic character: spadix many leaved; calyx three-leaved; petals three; stamens from fifteen to twenty; drupe coated, containing three seeds. The fronds are plaited like a fan; the terminal lobe is longest, which makes the whole appear as if winged.

BOUVARDIA (Salisbury). A genus of three species, and three varieties of green-house shrubs, natives of Mexico. Class and order *Tetrandria Monogynia*, and natural order *Rubiaceæ*. Generic character: calyx four parted, with intersecting teeth; corolla, tubular, limb four-cleft, filaments are joined to the tube, anthers as high as the top of the tube; style simple, stigma two-lobed; capsule, two-celled, seeds margined. Some of these are beautiful plants; particularly the *B. triphylla* and *B. versicolor*.

BOWICA (Haworth). A genus of two species of half shrubby plants, natives of Southern Africa. They belong to the class and order *Hexandria Monogynia*, and the natural order *Hemerocallideæ*. The flowers are very curious in structure, and the plants are easily managed.

BOX ELDER. The English name of a tree formerly called the Ash-leaved Maple. It was then *Acer negundo*, but has been made a new genus by Moench, under the name *Negundo Fraxinifolium*; and by Decandolle, as *Negundium Americanum*. In ornamental planting the tree is useful; it not only grows quickly, but its foliage is of a light yellowish green, contrasting well with deeper tinted trees. It has, however, two defects: the timber is inferior, and so brittle, that the tree is frequently demolished by high winds. There is a variety of it called *N. crispa*, or curled leaved, cultivated in nurseries for the ornamental planter. The tree is raised from seed like the common maple.

BOX THORN is the *Lycium* of Linnæus. A genus of handsome shrubs and climbers from the south of Europe and other parts of the world. Class and order, *Pentandria Monogynia*, and natural order, *Solaneæ*. Generic character: calyx bell-shaped, five-toothed, often cut in the sides; corolla funnel-shaped; stamens inserted in the tube of the corolla; filaments hairy at the base; berry two-celled, many seeded. Some of these plants, especially those from the Cape, are fine flowering plants. *L. Barbarum*, though a native of Barbary, succeeds in the open air in England; and, from its quick growth, is useful for covering arbours and the like. Some of the species bear thorns on their branches; hence the English name.

BOX TREE. This well-known plant is the *Buxus sempervirens* of Linnæus, who placed it in the twenty-first class, and fourth order of his system, viz., *Monœcia Tetrandria*. In the natural system it is associated with *Euphorbiaceæ*. There are four species; three are exotics, and the fourth, *B. sempervirens*, is indigenous to England, and of which there are two varieties, the narrow-leaved and the subshrubby.

BRABEJUM (Linnæus), is the African Almond. It belongs to *Polygamia Monœcia*, and to the highly ornamental order *Proteaceæ*. This is an elegant flowering plant; the racemes of blossoms are aptly compared to a sceptre.

BRACHELYTRA (Cuvier; MICROPTERA, Gravenhorst). A group or sub-section of beetles of considerable extent, belonging to the section, having five joints in all the tarsi (*Pentamera*), and corresponding with the Linnæan genus *Staphylinus*. The insects composing this sub-section are distinguished easily by the shortness of the wing-covers, which, although they entirely conceal the organs of flight, when folded up, are yet seldom more than one-third of the length of the abdomen, the remainder of which is consequently exposed. The wings themselves are of a large size (whence the impropriety of the name given to the insects by Gravenhorst, signifying small wings); but by means of numerous folds, and owing to their very thin and delicate structure, they are easily shut up and hidden beneath their two short covers. Unlike the ground beetles, *Carabidæ* (to which these insects are related, according to Latreille), the lower jaws are armed only with a single pair of palpi, or feelers; or, more strictly speaking, the terminal exterior portion of these organs, instead of exhibiting the form of a palpus, as it does in the latter insects—a peculiarity of organisation beautifully dependent upon correspondent peculiarity of economy—is either entirely soldered to the organ of which it is a part, or appears in the form of a dilated and inarticulate appendage; the antennæ are short, and either of an equal thickness throughout, or thickened at the tips, and composed of moniliform, or cup-shaped joints.

By Linnæus these insects are arranged at the end of the *Coleoptera*, and by some authors they have been considered as forming a passage to the next order, the *Orthoptera*, at the head of which the earwig (*Forficula*) is placed. It is not to be denied that there is great similarity in appearance between some of the moderate-sized species of this sub-section of the earwigs, especially in the shortness of the wing-covers and the exposed abdomen, as well as in the terminal appendages of the body, which, although they are of a large and forceps-like construction in the ear-wig, are evidently represented by the pilose setæ which the brachelytra possess at the same part of the body. In their habits there is likewise considerable similarity, as well as in their peculiar movements; but it is with the necrophagous beetles (*Silpha*, Linnæus) that the greatest number of relationships may be perceived, and which become so striking amongst some of the smaller species, that entomologists have been perplexed to assign them to their true location. The genus *Micropeplus* may be cited as an instance. The head is generally large and flat; the jaws strong; the thorax as broad as the abdomen; the wing-covers cut off square at the extremity, and the abdomen, instead of having its upper surface of a membranous or coriaceous texture, as it is in those beetles which have this part of the body entirely covered by the wings and wing-cases, is scaly both on its upper and under side.

The Devil's Coach-horse, as the insect is often termed, *Staphylinus* (*Ocypus*) *olens* of Linnæus, may be mentioned as one of the most common, and at the same time largest, species of the sub-section. It is of a dull black colour, with pale reddish wings, and is about an inch long. It is often to be seen running along footpaths, and in obscure places, such as outhouses, damp cellars, &c. When alarmed at the approach of danger, it assumes a most ferocious attitude; the jaws, which are very large and hooked, are opened wide, ready to seize the approaching object; the abdomen is thrown over the back, and from its extremity are protruded not only the pair of conical pilose appendages above noticed, but also several

Gærius Olens.

white fleshy vesicles, from which a subtle vapour is emitted, which has a very disagreeable scent. M. Dufour, whose researches upon the internal anatomy of insects are almost unrivalled, and have been already alluded to in this work under the article BOMBARDIER BEETLE, has published a description of the apparatus producing this vapour in the 8th volume of the "Annales des Sciences Naturelles." The abdomen is endowed with very considerable powers of motion, being capable of inflexion in almost every direction; and it is by its assistance that the large wings are folded and unfolded with surprising quickness. We have noticed some of the philonthi, &c., expand their wings, and take flight almost as quickly as a common fly; when on the wing they are equally agile, and they run with great swiftness. It has been stated that these insects feed upon others which they find in the places of their resort, carrying on a continual war with them, sometimes surprising them in their retreats, and at other times pursuing them with great ferocity. That they are very voracious is unquestionable; and their activity, and the powerful structure of the different parts of their mouths, fully confirms this opinion; but their voracity appears to us to be applied, not to living, but to dead animal or vegetable matter; and hence a minute examination of their mouth, and especially of their lower jaws, prove that they possess a very different structure from that which insects which prey upon others in a living state are known to possess. They are found under ground, in manure, under dung, and on fungi, beneath stones, &c.; and the opinions relative to their habits of feeding upon decaying animal or vegetable matter are confirmed by some circumstances connected with this kind of habitation. We are aware that the opposite opinion has been maintained by the great observer of insects, Dr. Geer, who relates, that having presented a fly to a large species of staphylinus, the latter seized it at once, and at length tore it in pieces with its teeth; but we do not hesitate to state, that if one of these insects be confined, and even a bit of wood or paper be presented to it, the result would be the same. The circumstances to which we would more particularly allude result from the geographical distribution of insects, and the analogy existing between the manners of the brachelytra and other insects which feed upon decayed vegetable or animal food.

Who is there that has not, in his twilight rambles, observed the shard-borne beetles (*Geotrupes stercorarius*) flying about some particular spot, unconscious of every object, and dashing against whatever may be in their way, with all the blindness of a beetle, their numbers increasing every minute? This assemblage is occasioned by the attraction afforded by the scent of some new-laid dung upon or near the spot, and upon which they feed with avidity. It is precisely in the same manner that the species of the brachelytra swarm in the same situations. How often is it that, in walking along some shady lane in the heat of the summer, we have been half blinded by these little torments flying unconsciously into our eyes, occasioning a smarting pain, greatly increased by the emission of the fluid or vapour which, as above stated, these insects have the means of discharging, and which has terminated only by the extraction of the little animal, which, instead of a choice repast*, has found, in all probability, a watery grave. This continued searching after their food has caused these insects to be termed rove-beetles in our common language; and the circumstance, that a group of insects should have received a general vernacular term in England, (that of rove beetles,) whilst the numerous continental entomologists have not conferred upon it any other than its scientific denomination, is one which, although it may appear to be unworthy of notice, is a striking indication of that peculiarity in the geographical distribution of these insects to which we have above alluded.

In Great Britain, we possess nearly eight hundred species, described by Mr. Stephens. Now, De Jean, in the new edition of his Catalogue of Coleoptera from all Quarters of the Globe (1833), does not enumerate more than this number. From the tropical climes of Asia and America we possess scarcely any species. In fact, Great Britain has been regarded as the metropolis of the group; and it is a singular circumstance, that not a single insect of the brachelytra was collected by Dr. Horsfield during his long researches in Java. That they sparingly exist in that country cannot perhaps be doubted, because, both from India and New Holland have species been received, but in all those parts of the world their numbers are very trifling indeed. Let us look, however, at the cause of this, and its apparent singularity vanishes. "In Java, as in all other tropical climates, the surface of the earth is almost exclusively occupied by ants; and, according to Dr. Horsfield, when the common ants are not found, the termites, or white ants, possess the territory. These two tribes, which are constantly at war, or rather, which clear away and destroy each other as their numbers respectively predominate, have in a great measure divided the surface of the island among themselves. From their incredible numbers, particularly of the common ant, little is left on the surface for other insects. Swarming in every spot, and incessantly in motion, they attack and devour whatever *animal* matter they meet with in a much shorter period than would be thought possible by a person who had not witnessed the fact. But, nevertheless, whenever, in his excursions, Dr. Horsfield observed the carcass of any animal, he and his assistants carefully examined it, and, from the care they took in such labours, he is convinced that, had silphidæ, staphylinidæ, and such *carrion*-feeding families of insects occurred in any tolerable abundance, they would scarcely have escaped his researches. With respect to such genera of brachelytra as inhabit flowers, he scarcely conceives, had they been common, that they would have escaped him, as he was in the constant habit of collecting on plants and flowers."—MacLeay, *Annulosa Javanica*. This author, it will be seen, speaks only of carrion feeders, and those inhabiting flowers; but the fact of their feeding upon decaying vegetable matter is known to every practical entomologist. Indeed, from this circumstance one of the genera has derived its name. See the article BOLETOBIUS.

Some species, forming the genera *Pæderus* and *Stenus*, are generally found upon the margins of streams or standing water, whilst others, of a small size, as the *Omalia*, frequent flowers in the perfect state.

The larvæ nearly resemble the perfect insects in shape, being long and narrow, with the head broad and large, but the wings and wing-covers are entirely wanting; the legs, which are six in number, are attached to the first three segments of the body, which gradually becomes more slender to the extremity, terminating in an elongated tube, armed at each side with a long and slender hairy jointed filament. These larvæ are found in the same situations, and prey upon the same substances as the perfect insects.

In the Linnæan system only twenty-six species belonging to this sub-section were described under the genus *Staphylinus*. As, however, the group became better known, and the number of species greatly augmented, various generic groups were detached by Fabricius, Gravenhorst, and others. The group was, however, restored to its original limits, by its establishment as a distinct sub-section, comprising numerous genera, and by the distribution of the latter, according to the comprehensive views of Latreille, into several tribes; namely, 1. the *Fissilabres* (cleft-lipped); 2. *Longipalpi* (having long palpi); 3. the *Denticrura* (having toothed tibiæ); 4. the *Depressa* (flattened bodies); and 5. the *Microcephala* (small-headed). To these tribes the Count Mannerheim, in a valuable memoir upon this family, contained in the first volume of the Memoirs of the Imperial Academy of Sciences of St. Petersburg, has added another, under the name of the *Aleocharides*, a step which we had long previously proposed in a memoir upon these insects, published in the Zoological Journal. To these another group is also referable, namely, the extraordinary family of *Pselaphidæ*, which, from having been supposed to possess only two joints in the tarsi, had been formed by Latreille into a distinct primary section of the *Coleoptera*, under the name of *Dimera*. As, however, their general structure agrees with some of the minute brachelytra, and as some of the latter have only three joints in the tarsi, the grounds for their separation become untenable, and they have accordingly, by Messrs. MacLeay and Stephens, been introduced into the brachelytra.

As the work of Count Mannerheim is the latest containing a general revision of the group, and moreover, as it is in the hands of very few English entomologists, we have thought that the following slight synopsis of the classification contained in it may not be uninteresting to our readers, premising only, that some other genera have been described by Mr. Stephens in his Illustrations of British Entomology, and of which the Count Mannerheim was ignorant.

Tribe 1. STAPHYLINIDES (*Fissilabra*, Latreille).

The head is separated from the thorax by a narrow neck, so as to be entirely disengaged; the thorax is square, semi-oval, rounded or truncate-cordate; the

* Practical collectors of insects are well aware that the most advantageous method of obtaining these insects is to immerse pieces of dung, or such like matters, in a pail of water, when the beetles rise to the surface, and are easily secured.

upper lip is divided by a deep slit in the centre into two lobes.

Genera: 1, *Oxyporus*, Fabricius; 2, *Astrapæus*, Gravenhorst; 3, *Velleius*, Leach; 4, *Creophilus*, Kirby; 5, *Emus*, Leach; 6, *Staphylinus*, Linnæus; 7, *Cafius*, Leach; 8, *Physetops*, Mannerheim, new genus, from Tartary; 9, *Gyrohypnus*, Kirby; 10, *Eulissus*, Mannerheim, new genus, from Brazil; 11, *Platyprosopus*, Mannerheim, new genus, from Caucasus; 12, *Lathrobium*, Gravenhorst; 13, *Cryptobium*, Mannerheim, new genus, from Sweden; 14, *Achenium*, Leach.

Tribe 2. Stenides (*Longipalpi*, Latreille).

The head is disengaged, but the labrum is not notched; the palpi are as long as the head, terminated in a club at the extremity of the third joint, the fourth being very minute.

Genera: 1, *Pæderus*, Fabricius; 2, *Rugilus*, Leach; 3, *Eristhetus*, Knoch; 4, *Dianous*, Leach; 5, *Stenus*, Latreille.

Tribe 3. Oxytelides (*Denticrura*, Latreille).

The palpi are much shorter than the head, with four distinct joints; the anterior tibiæ toothed or spinose on the outside; the tarsi fold back upon the tibiæ, with the basal joints minute, or even obliterated; the last joint very long.

Genera: 1, *Bledius*, Leach; 2, *Platystethus*, Mannerheim, new genus (*Oxytelus cornutus*, Gyll, &c.); 3, *Oxytelus*, Gravenhorst; 4, *Trogophlæus*, Mannerheim, new genus (*Oxytelus corticinus*, Gravenhorst).

Tribe 4. Omalides (*Depressa*, Latreille).

The head is disengaged, the lip entire, the palpi short and four-jointed; but the tibiæ are simple and unarmed, and the tarsi evidently five-jointed.

Genera: 1, *Phloeocharis*, Mannerheim, new genus, from Finland; 2, *Tænosoma*, Mannerheim, new genus, from Russia; 3, *Omalium*, Gravenhorst; 4, *Anthobium*, Leach; 5, *Acidota*, Kirby; 6, *Lesteva*, Latreille; 7, *Proteinus*, Latreille; 8, *Micropeplus*, Latreille.

Tribe 5. Tachinides (*Microcephali*, Latreille).

The head is immersed as far as the eyes in the thorax, upper lip rounded, legs spiny, antennæ inserted in front of the eyes.

Genera: 1, *Hypochyptus*, Schuppell; 2, *Tachyporus*, Gravenhorst; 3, *Tachinus*, Gravenhorst; 4, *Myectoporus*, Mannerheim, new genus, from Sweden; 5, *Boletobius*, Leach.

Tribe 6. Aleocharides, Mannerheim.

Lip entire, squared in front; legs not spined; antennæ inserted beneath the eyes; head sometimes having a distinct neck.

Genera: 1, *Dinarda*, Leach; 2, *Lomechusa*, Gravenhorst; 3, *Gymnusa*, Karsten; 4, *Aleochara*, Knoch; 5, *Sphænoma*, Mannerheim; 6, *Oxypoda*, Mannerheim; 7, *Microcera*, Mannerheim; 8, *Oligota*, Mannerheim; 9, *Trichophya*, Mannerheim; 10, *Homalota*, Mannerheim; 11, *Gyrophæna*, Mannerheim; 12, *Boletochara*, Mannerheim; 13, *Drusilla*, Leach; 14, *Calodera*, Mannerheim; 15, *Falagria*, Leach; 16, *Autalia*, Leach.

Tribe 7. Psilaphides.

This tribe is not comprised in Count Mannerheim's work. Reference must be had to M. Aubé's Memoir, recently published in Paris, upon this tribe.

BRACHINIDÆ (Mac Leay; Truncatipennes Latreille). A family of coleopterous insects, belonging to the section *Pentamera*, and separated from the great Linnæan group of *Carabus*. In this family, which comprises numerous and very differently constructed insects, the maxillary palpi are not terminated by a minute conical joint, as in the *Bembidiidæ;* the anterior tibiæ are not entire and without a notch, as in the *Carabidæ;* the anterior tarsi are not dilated in the males, as in the *Harpalidæ;* and the fore legs are not formed for burrowing, nor the thorax separated from the elytra by a sort of neck, as in the *Scaritidæ*. A character which is found in the more typical genera is to have the elytra squared off at the extremity, whence Latreille's name; but there are many of the genera in which they do not exhibit this structure. The head and thorax are narrower than the elytra, and the labium is seldom accompanied by lateral filaments.

Many of the species are much more elegantly ornamented with various colours than the majority of the Linnæan *Carabi*, and the species do not appear to be so voracious in their habits as the *Scaritidæ*, *Harpalidæ*, &c. Of the habits of the exotic species, however, but little is known. The British species of some of the genera (as *Odacantha*, *Polystichus*, &c.) frequent sandy districts on the sea-shore, or the meres of Huntingdonshire and Cambridgeshire; others, as the *Brachini*, prefer damp situations on the margins of rivers, &c., whilst some are generally found in gravel pits or beneath the bark of trees, as the *Dromii*, some of which hybernate in the latter situation. We have already, under the article Bombardier Beetle, given an account of the habits of the genus *Brachinus*. Many of the species are destitute of wings.

Messrs. Audouin and Brulle, in their valuable "Histoire Naturelle des Insectes" (of which the publication in parts has recently commenced), have divided this family into six minor divisions. 1, *Trigonodactyliens;* 2, *Odacanthiens;* 3, *Zuphiens;* 4, *Lebiens;* 5, *Brachiniens;* and 6, *Graphipteriens*.

The *Brachiniens* are distinguished by their short filiform palpi, and the convexity of their bodies. In this division are placed the genera *Brachinus*, Weber; *Aptinus*, Bonelli; *Pseudaptinus*, Laporte; and *Corsyra*, Steven. The first of these (which is the only genus found in this country) is distinguished by the presence of a pair of large wings beneath the elytra, and by the mentum having a deep notch without any central tooth. The claws are not toothed, and the body is thick and convex, with the elytra but slightly truncate. There are five British species of this genus, of which the type *Brach-crepitans*, Linnæus, is the most common and best known.

BRACHIONUS. One of those singularly interesting genera of microscopic animals discovered in infusions of vegetable or animal matter, therefore named by Linnæus *Infusoria*, and by that great naturalist placed in the fifth order of the class *Zoophyta*, forming the last division of the animal kingdom. The brachionus is nearly invisible, or only appears as a moving atom; its motions are various; it is seen to attack, or fly from an enemy, and in a second voluntarily to change its shape, being constantly occupied in search of food, or performing its other animal functions; the body is highly contractile, covered with a shell with rotatory cilia, and in many the internal structure is visible. The burecolaris is the only species yet described; it is found most frequently in stagnant waters.

The prodigious improvements microscopes have undergone in their construction, and the power given them by the application of the united flame of hydro and oxygen gases, have led to discoveries in the animal creation, beyond the imagination of man to conceive; a single drop of water is now seen to possess countless numbers of organised beings, each pursuing the functions of life ; each endowed with its own peculiar habits or purposes, and all playing parts in their sphere of life, no less important in the scale of creation than those of the unwieldy elephant or the gigantic whale. Could more be required to exhibit the infinite wisdom of Nature's God, were every other proof to fail ? This subject, so interesting in every point of view, will be most amply treated under the article INFUSORIA.

BRACHIURUS. A section of American monkeys, found chiefly or exclusively in the woods of the warmer parts of that continent. The chief distinguishing character is that upon which the name is founded, the tail shorter than the body. There are two species described, one with the body yellow, and the extremities, the head, and the tail black ; and the other with the head black, and all the rest yellow. The first is *Brachiurus auaraki* of Spix, and figured in Plate VIII. of his great work ; the other is *Simia melanocephala* of Baron Humboldt.

BRACHYCERUS (Fabricius). A genus of coleopterous insects belonging to the section *Tetramera*, or beetles having four joints in all the tarsi, to the subsection *Rhyncophora*, or those having the face prolonged into a snout, and to the family of the weevils, *Curculionidæ*, in which family it forms a group of species distinguished from all the others by having the antennæ, which are but slightly elbowed at the extremity of the first joint, short, composed of nine joints, and inserted near the tip of the snout, and the tarsi not cushioned beneath. They are destitute of wings, the body is very convex, the abdomen and elytra being nearly globular. These insects, which are amongst the largest of the weevils, do not frequent flowers, nor are they ever found upon trees and plants, like the majority of the family. Their wingless state compels them to remain on the ground, where they creep along with great heaviness, and without the least agility. Here, therefore, we have a perfect contrast with the equally wingless ground beetles, as many of the *Carabidæ*, which, in order to compensate for the want of organs of flight, are endowed with an increase in the power of locomotion in their legs. The legs of the *Brachyceri* are, indeed, as thick and as long as in many of the latter insects; but it would almost seem that it was merely for the purpose of supporting, rather than bearing along, their heavy and unwieldy bodies. Let us however look at the habits of the two groups, and perhaps we may be aole in some measure to account for the difference ; the *Carabidæ*, we know, are amongst the most voracious of insects, feeding upon others in a living state ; hence we find them enabled to pursue their prey by means of their increased agility. On the contrary, all that we know of the habits of *Brachyceri* is, that they abound in the sandy districts of the south of Europe and in Africa, and that they appear early in the spring. But analogy gives us this further insight into their economy ; the similarity in the construction of their oral apparatus with that of the weevils, allowing us to draw the inference that they feed upon vegetable substances, most probably the roots of trees, or smaller plants. Hence no additional agility is required to enable them to obtain their livelihood, neither is it required, as we have taken occasion to observe under the article BLAPSIDÆ, as a means of defence, because the *Brachyceri* are clothed in a coat of mail not less powerful than that of any other coleopterous insect.

The Ethiopian women suspend the body of some of these insects round their necks, by means of a thread, as a kind of amulet.—*Voyage de M. Cailliaud au Fleuve Blanc.*

Schonherr, in his invaluable work upon the Curculionidæ (now in course of publication), has described 112 species of this genus.

BRACHYLOPHUS. A genus of saurian reptiles, bearing considerable resemblance to the iguana lizards, but differing from them in having no teeth on the palate, and small teeth in the jaws. The scales on the body are small ; there is a small crest on the neck and back ; and a row of pores on the inside of each thigh. They are, like all the rest of the tribe, lively and harmless creatures, sporting in the sun in hot climates.

BRACHYPODIUM (Beauvois). A genus of uncultivated grasses, consisting of twenty-two different species, three of which are British, and the rest continental.

BRACHYPTERA (short wings). One of the four families into which Cuvier divides the web-footed birds. (See the article BIRD.) These birds are the divers properly so called. They bear nearly the same relation to the water-rails that the web-footed birds which do not dive bear to common poultry. Their legs are placed much farther backward than those of any other birds, and they walk with difficulty, and carry the body in an upright position. They are in general bad fliers, and some of them are incapable of flight, their proper element being the water, on the surface of which they repose, and in the body of which they seek their food. Their plumage is remarkable for its closeness, the polished lustre of its surface, and its water proof quality. It is never harmed by the longest exposure to the watery element, nor does it appear to need much dressing from the birds themselves. When under the surface they use their wings like fins, and "keep stroke" with them and their feet, swimming very much after the manner of frogs. The principal genera are GREBES, DIVERS, GUILLEMOTS, AUKS, and PENGUINS, under which titles some account of their appearances, characters, and manners, will be found.

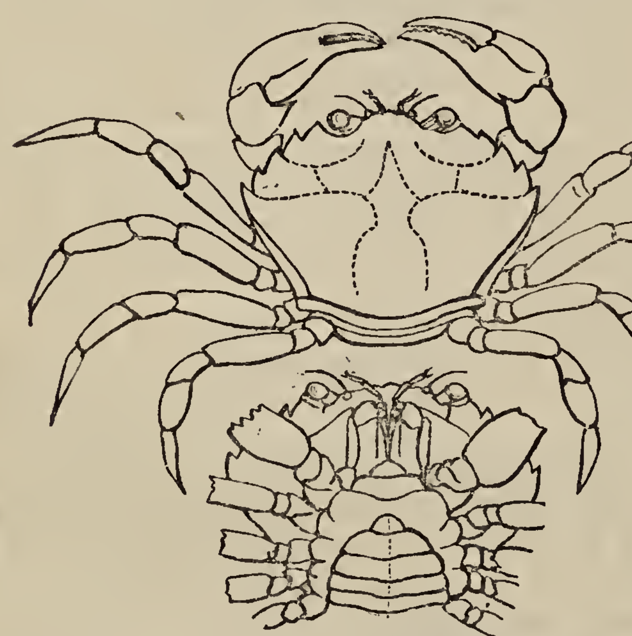
BRACHYSEMA (Robert Brown). A family of two species of evergreen trailing plants from New South Wales. Class and order, *Decandria Monogynia ;* natural order, *Leguminosæ.* Generic character : calyx five-cleft, somewhat unequal, with a swollen tube ; standard shorter than the compressed keel, which latter is as long as the wings ; pod on a stalk, surrounded at the base by a little shield ; style filiform, long, crowning the pod, which is swollen. These plants are met with in botanical collections.

BRACHYSTELMA (Robert Brown). A curious tuberous-rooted plant from the Cape of Good Hope. Natural order, *Asclepiadeæ.*

BRACHYURA (Latreille). One of the chief divisions of the class *Crustacea*, belonging to the section *Malacostraca*, or those with a hard shelly covering; subsection *Podopthalma*, or those with the eyes placed at the extremity of footstalks ; and to the tribe of *Decapoda*, or those which are furnished with ten legs. These characters, body encased in a hard shell, eyes pedunculated, and legs ten in number, are common to the greatest portion (in point of number) of the whole class, the animals which possess them are of large size, being in fact the giants of the class.

The edible crab and the lobster may be cited as the two best known species belonging to the *Decapod* tribe of *Crustacea*; but these two animals differ materially from each other in their structure. In the former the body is broader than long, the abdomen very slightly developed, incapable of being employed in swimming, unfurnished beneath with lamellated false legs, as they are termed, and not terminated by an apparatus for swimming. In the latter the reverse of all this takes place: the abdomen or tail of the lobster, as every epicure can tell, is very much developed, generally longer than the body, which is narrower than long, and furnished beneath with short natatory appendages, and terminated in a fan-shaped swimming apparatus. Now these two animals form the types of two of the chief divisions of the *Crustacea*, the former representing the order *Brachyuri*, or short-tailed crabs, and the latter the order *Macrura*, or long-tailed lobsters. These two orders or divisions, in the arrangements of the majority of authors, comprise all the decapod *Crustacea;* but M. Milne Edwards, one of the most celebrated of modern crustaceologists, in a valuable work published at Paris, in 1834, has proposed the establishment of another or third division, under the name of *Anomoures*, forming a passage between the two other groups, and composed of various species which appear to belong to neither, and which, if introduced amongst them, would violate the spirit of all natural arrangement.

In the various animals which compose the division *Brachyura*, the shell or carapace which covers their bodies, also conceals the greatest portion of the abdomen, and is in general of a square oval or rounded form, its transverse diameter exceeding, or at least equalling its length, its upper surface exhibiting various areas divided by impressions which correspond for the most part with the insertion of the muscles within the shell, and which form so many regions corresponding with the internal organs immediately beneath the different areas. The front of this shell bears a pair of eyes placed on footstalks, and two pairs of antennæ, and beneath these is perceived a pair of large, flat, and articulated pieces, which when raised, are found to conceal a very complex apparatus composing the mouth, and consisting of an upper lip and tongue, a pair of horny mandibles bearing a jointed palpus, a pair of internal* and external maxillæ, and three pairs of foot jaws gradually increasing in size, furnished with palpi, the largest of which is the external pair first mentioned above. Beneath the antennæ is also placed a pair of apertures which have been regarded as organs of hearing. The members, which immediately succeed the external foot-jaws constitute the legs, and are also five pair in number; they vary considerably in size; those of the first pair are always prehensile, and terminated by a didactyle and well-formed claw; in general the four posterior pairs of legs are simply ambulatory or natatory, they are never didactyle. The abdomen is but slightly developed, its length never exceeding three-fourths of that of the entire body, and its thickness not equal to more than one-sixth or one-tenth of the body, being in fact lamellose, and always closely applied to the sternal excavation. It is essentially composed of seven segments, but it often occurs that some of these are so intimately soldered together, that this part of the body appears to be only five, four, or even three-jointed. In general it is much larger in the females than in the males, being oval in the former and somewhat triangular in the latter.



Carcinus Mœnas.

We shall reserve for the article Crab, our observations upon the habits of this division, and shall here simply give the chief subdivisions into which it has been separated. This division comprises a very great number of species, respecting the classification of which crustaceologists are not yet agreed. Dr. Leach, followed by M. Desmarets, arranged the groups according to the number of pieces of which the abdomen is composed, both in the males and females,—a very simple plan, and one of very easy application, but at the same time one which produces the most artificial results, some species belonging to the same natural genus being removed thereby to different families. M. Latreille, on the contrary, founding his earlier classifications upon the general form of the body and the disposition of the feet established seven families, namely, the *Nageurs* (paddle-legged), *Arqués* (arched front), *Quadrilateres* (four-sided), *Orbiculaires* (orbicular formed), *Triangulaires* (triangle formed), *Cryptopodes* (hidden legged), and *Notopodes* (dorsal footed). Subsequently, however, he took into consideration the form of the mouth and some other characters in addition to the preceding, the result whereof was the union of the *Nageurs* and *Arqués* into one family, and the modification of the others. This latter classification has appeared the most natural of any hitherto proposed to M. Edwards, who (from a profound investigation of the structure of the different groups) has been induced further to modify various portions, and to subdivide the *Brachyura* into only four great families, which he terms *Oxyrhynches*, *Cyclométopés*, *Catamétopés*, and *Oxystomes.*

The Oxyrhynchi comprise the various species of crabs known by the name of sea-spiders. The legs are long, the shell more or less narrowed in front into a beak, the epistoma (or part of the head between the antennæ and mouth) very large and nearly square This family comprises three tribes, *Macropodiens*, *Maiens*, and *Parthenopiens.*

The Cyclometopi has the shell very large, regularly curved in front and narrowed behind; the legs are of moderate length; the epistoma is very short, and much wider than long. The abdomen of the male occupies all the space between the hind legs. This family comprises two tribes, the *Canceriens* and the *Portuniens.* The former comprising three subtribes, the *Cryptopodes*, *Arqués*, and *Quadrilateres.* The type is the common edible crab.

* By some accident M. Edwards has described the internal maxillæ as the anterior foot jaws, page 255.

The CATAMETOPÉS have the shell quadrilateral or ovoid, with the front transverse and knotted; the epistoma very short, the abdomen of the male not occupying the space between the hind legs.

The OXYSTOMES have the shell orbicular and arched in front, which is not produced into a point. The epistoma is obsolete.

BRACONIDÆ (Stephens). A family, or rather subfamily, of hymenopterous insects belonging to the section *Pupophaga*, and forming a portion of the Linnæan genus *Ichneumon*. They are distinguished from the true ichneumons by wanting the internal discoidal cell of the upper wings, by having the maxillary palpi five-jointed, and the labial ones either three or four jointed; the recurrent nerve is either unique or entirely wanting. The appearance of these insects bespeaks a certain weakness of structure. They are of small size, their legs are long, the abdomen is attached by its whole breadth to the thorax, or is sometimes pedunculated, the ovipositor is often exserted, the wings are generally obscurely coloured, with bands or spots, the prevailing colours are luteous red and black, the antennæ are never ornamented with a pale band, the maxillary palpi are often very long, and the labial always short. There is considerable difference in the details of the economy of these insects, all however are parasitic in their larva state within the bodies of other insects.

The species of Aphidius prey upon the plant-lice; one of them having been long known to entomologists under the name of *Ichneumon aphidum* of Linnæus and De Geer, but as the specific name has been transformed into a generic one, it has become necessary to substitute another term. Nees von Esenbeck has accordingly given it the name of *Aphidius varius* in his Hymenopterorum Monographiæ (1834), whilst Mr. Haliday, from finding it attached to the plant-lice of the rose trees, has termed it *Aphidius rosæ*, a name scarcely correct since it does not feed upon the rose but upon the insects which swarm upon that plant; moreover, Esenbeck obtained it from the aphides of the pine and buckthorn. As this is a genus of considerable extent and interest, (Mr. Haliday having described upwards of forty British species,) and as it was omitted in its place in the alphabet, we shall here give some account of it. It is distinguished

Aphidius Rosæ.

by the abdomen being pedunculated, the maxillary palpi five-jointed, the labial with three equal joints, and the peduncle smooth. We are indebted to Mr. Haliday for a very interesting account of the habits of the species above named, and which, although we have ourselves repeatedly observed the proceedings of these insects, we prefer giving in the words of that elegant writer. "This is the species most frequently noticed by authors, being a familiar inhabitant of our gardens, where the male may be seen throughout the summer hovering over the rose trees, or creeping under the leaves. His partner is of less roving habits and will generally be found busy in providing for the establishment of her numerous progeny. Placed at her birth amid the myriads of pucerons which encircle the young shoots of the rose, she has no dwelling to construct with artful industry, nor stores of food to collect by distant rovings. With extended antennæ and wings shivering with desire, she paces leisurely among the defenceless herd, and as soon as she has selected one by a light touch of her antennæ, she stops short at about her own length from it, and rising on stiffened legs bends her abdomen under her breast till the end of it projects beyond her mouth, then erecting her thorax by depressing the hinder part she simultaneously makes a plunge forward with the abdomen which is then extraordinarily lengthened, and by a momentary touch deposits an egg on the under side of the puceron near its tail. The victim will sometimes kick and sprawl so as to discompose her, but, being anchored by its sucker plunged in the bark, can make no effectual attempt to elude the deadly weapon. Should it, however, be wandering at large, and free to struggle, she shows great activity in traversing around it in the attitude of attack till she can take it in flank. The delicate sense of the antennæ seems to warn her where a germ has been already deposited, as she will pass by those which have been stung some days before; and I have never found more than a single grub in each individual. When all the interior of the puceron is consumed it will be found separate from its fellows, and motionless usually on the upper side of a leaf, to which it is glued by some viscid exudation. It now appears distended and of an opaque hazel or lighter tint. If opened the full fed grub of the aphidius will be discovered doubled up and filling the cavity, its head being next the tail of the puceron. In a short time the parts of the perfect insect are developed in a quiescent state, and in the same position, the integuments of the grub being shrivelled up below as if in black grains. Like cynips and cullimome, it spins no cocoon for its transformation, being adequately protected by the indurated skin of its victim. A few days are sufficient to give consistence to its parts; and while the new risen sun is yet glistening in the early dews, the winged insect by a push of its head detaches the latter rings of its case, which separate in the form of a circular lid, often springing back to close the orifice after the inhabitant has gone forth, born in the maturity of her energies and instincts, to renew the circle of existence."

The other genera belonging to this family are, *Stephanus*, Jur.; *Cœlinius*, N. ab E.; *Spathius*, N. ab E.; *Perilitus*, N. ab E.; *Hybrizon*, Fallen; *Leiophron*, N. ab. E.; *Bracon*, Fabricius; *Agathis*, Latreille; *Microdus*, N. ab E.; *Hormius*, N. ab E.; *Ichneutes*, N. ab E.; *Microgaster*, Latreille; *Blacus*, N. ab E. Mr. Haliday has added several others, such as *Mirax*, as well as various subgenera.

The genus *Bracon*, forming the type of the family, is distinguished by its sessile abdomen, five-jointed maxillary palpi, three-jointed filiform labial palpi, with the abdomen longer than the thorax, slightly convex or depressed, the segments gradually decreasing in size, the jaws horny and toothed, and the antennæ setaceous. This genus is for the most part composed of elegant exotic species having coloured wings. There are about twenty British species, chiefly of small size. They are generally found amongst plants or upon trees, running about the leaves upon which various larvæ are feeding, whence it may be inferred that they are lurking about with a view to deposit their eggs in the bodies of such insects.

The genus *Agathis* has the lower parts of the mouth produced into a rostrum. Such of the other genera as present any feature of interest will be treated of in their place in the alphabet.

BRADYPUS (Sloth). A genus of mammalia, constituting the *tardigrada*, or "slow-going animals" of Cuvier's order *Edentata*, or "toothless animals," as they have no cutting teeth.

Their grinders are cylindrical, and their canine teeth longer than the grinders, and pointed. They subsist wholly upon vegetable food—the leaves of trees; and they inhabit the trees constantly, living suspended by their claws with the back undermost, and seldom or never coming to the ground. They are very singular animals, and in some respects combine the characters of the apes and other four-handed animals with those of the ruminants; but it does not appear that any of them ruminate, and though their stomachs are divided into four sacs, these have not the same distinct appearance and character as those of the animals which do ruminate, though, like them, they are adapted for digesting green vegetable matter.

The females have two pectoral mammæ, like the apes. The phalanges of the toes are united within the skin, so that there appears no division of the feet except the claws, which are very large and strong, and much hooked. The state of repose of these immense claws, when they are not grasping, is that of being turned flat down upon the palm or sole; and there are stops on the joints that prevent their opening further than to form a hook by which the animal is suspended. Their hind feet are articulated obliquely to the legs, so that the outer edges of them, and not the soles, come to the ground when the animals attempt to walk. The articulation of the toes are perfect hinges, having motion in one plane only, and at a certain age the first phalanges are united to the metacarpal and metatarsal bones; so that altogether the extremities of the feet have much less motion than those of any other animals. The fore and hind legs too, are not so very disproportioned to each other as those of the long-armed apes, but still the arm and fore-arm are both so much longer than the thigh and leg that the animals cannot use them with advantage upon the ground. The whole of the hind legs are articulated more for motion across the mesial plane of the body than for motion in that plane, which is the proper walking motion of animals upon the ground, and supporting the weight of the body. The articulation which gives the cross motion is the proper climbing one, as the legs are adapted for being pressed close together, or of being extended far apart, so that they may take hold of a branch at some distance.

There are only two existing species of these singular animals, the AI and the UNAU, under which names particular descriptions will be found; but it appears that at some former period of the history of South America (probably the same at which those large animals, whose bones are now found in the more northerly parts of both continents, inhabited the swampy marshes there), there were animals of the same or similar structure, of much larger dimensions, as their remains are still to be found. See the articles MEGALTHERIUM and MEGALONYX.

BRADYTUS (Stephens). A genus of coleopterous insects belonging to the section *Pentamera*, family *Carabidæ* and subfamily *Harpalides*, and nearly allied to *Amara* and *Zabrus*. From the former, with which it has been associated by some of the continental authors, it is distinguished by having the mental tooth entire and the body convex, and from the latter by having the thorax transverse and narrowed behind. The species are about a quarter or one-third of an inch in length, and are found in sandy and open situations. They are less agile than the majority of the subfamily. There are four British species in the genus, of which the *Carabus ferrugineus* of Linnæus is the type.

BRAKE is the *Pteris aquilina* of Linnæus: it belongs to an extensive family of ferns, comprising thirty-four species, all foreign except one, which is the brake or bracken of our British wastes.

BRAMA, a genus of acanthopterygeous, or spinous finned fishes, belonging to the family of *Squammipennes*, or those which have the fins, the anal and the dorsal, in great part at least, covered by scales.

There is only one known species, found chiefly in the Mediterranean, though it sometimes ranges into the Atlantic. The dorsal and anal fins are a little elevated at their anterior margins, and have a few spinous rays there; but the principal part of these fins is but little produced, and almost entirely covered with scales. There are seven rays in the gill-flaps; the profile is elevated, the muzzle short; the mouth vertical when closed, and they have teeth in the jaws and the palate. The stomach is short, the intestinal canal simple, and with five small cæca. They are esculent fishes. But they are much annoyed by intestinal worms, which injure their condition as food.

BRAMBLE is the *Rubus fruticosus* of Linnæus. This well-known plant needs no description; but it may be observed, that it belongs to a numerous family, natives of all the tropical parts of the world. There are sixty-three species, and several varieties. The fruit are provincially called "blackberries," and are used for different purposes of the housewife. The dewberry and cloudberry are, like the bramble, wild and eatable; and the excellent cultivated raspberry is an allied species. The long shoots of the common bramble are used by basketmakers and thatchers.

BRAMBLING, BRAMBLE-FINCH, or MOUNTAIN CHAFFINCH (*Spiza montana; Fringilla montifringilla*, Linnæus). This handsomely variegated chaffinch much resembles, in form and size, the common, or white-winged species, but is a trifle larger. The bill is of a lemon yellow, tipped with black, but changes in the summer to dark bluish grey. Irides, dark hazel. The crown of the head, cheeks, and back, a glossy black, inclining to blue; in the winter fringed with yellowish brown edgings, which conceal the black, but which gradually fall off on the approach of the breeding season. The feathers of the back are, at the base, ash-coloured, so that when the bird (in summer plumage) leans forward, the back seems of this colour, spotted with black, but appears, when in an upright position, wholly black. The nape of the neck ash-colour, with two longitudinal black lines. Rump white, bordered with black on each side. The throat, breast, lesser wing coverts (or the small feathers on the angle of the wing), and the termination of the greater wing-coverts, bright reddish orange, the last mentioned forming a band across the wing, as in the chaffinch. The base of the lesser wing-coverts dull white, forming another band, concealed generally by the plumage above; remainder of the wing black, the scapulars having their outer webs bordered with rufous, and the quill-feathers being slightly edged with primrose yellow, and having a white spot at the base; underneath the wing are some bright yellow feathers. The rest of the under parts white, tinged with rufous on the under tail-coverts and flanks, which latter are spotted with black. Tail black, edged with grey, the exterior web of the outer feather partly white. Legs and toes brown.

The female resembles the male in markings, but her colours are far from being as bright. The upper parts are of a blackish brown, margined in the winter with yellowish brown, and over each eye is a streak of black, which is continued down the back of the neck. Throat and breast yellowish orange. The young are similar to the adult female, but have the throat whitish.

This fine species is a native of the northern parts of Europe, and in the more temperate and southern districts is only known as a winter visitant, arriving in the neighbourhood of London generally about Michaelmas, and departing northward early in the month of March—never having, as yet, been satisfactorily ascertained to breed here. Their numbers vary greatly in different seasons, the direction and extent of their migration being, in all probability, regulated by the state of the weather.

In habit, and in their manners, they closely resemble the common chaffinch, with which they frequently associate, and in hard weather may sometimes be seen hopping familiarly about the farm-yard, or in the middle of the road, in the manner of that bird. They are found much about beech trees, and in plantations of larch and fir, where they may be readily distinguished from the chaffinch by the difference of their notes, the most frequent of which is a kind of *chut*, analogous to the *twink* of the chaffinch, and sometimes a harsh jay-like call to their companions. They are never heard to sing during the period of their stay in this country; but in confinement, in the spring and summer, they often utter a few coarse, unmusical notes, which appear to be all the melody they are capable of, and which do not in the least resemble the notes of the common chaffinch, nor those of any other bird with which we are acquainted.

The chaffinches, a group of which the present forms one of the most characteristic species, constitute a small but tolerably well-marked division, the members of which possess in common several little peculiarities at variance with the generality of finches. They subsist much on insect food, which (with the exception sometimes of a few aphides) the goldfinches, linnets, grosbeaks, and others, never touch, and, like the sparrow genus (*passer*), their young are wholly fed upon insects. The crop, or enlargement of the gullet, is very much smaller than in any of the other finches we have examined, and the muscular stomach, or gizzard, proportionably larger. They usually move forward on the ground by hopping, but when feeding, mostly by alternate steps; are in their habits familiar, much resorting to farm-houses, and other human habitations, and, like the other various finches, are in the winter more or less gregarious.

The mountain chaffinch is described to pass the summer in mountainous and wild districts, and to breed in the extensive forests of pine and fir which abound in high latitudes, constructing its nest of wool and moss, and lining it with feathers and hair, and is said to lay four or five white eggs, spotted with yellowish brown. It is, in confinement, tolerably familiar, if taken young, that is, during the winter of the first year; but the older birds remain extremely wild and untameable. In Russia it is very common, and the barbarous peasantry of that country are much in the habit of catching them for the purpose of making them fight with each other, or with other small birds, or mice, often risking greater sums on the issue of such a contest than their slender means can well afford. We were told this by a person long resident in St. Petersburgh, who also informed us of the mode of provoking them to fight: this, of course, we need not here repeat, but may remark, that the species is not naturally irascible; in the aviary we have always found them to live in perfect harmony with their various companions.

BRANCHIFERA. The second family of the second class *Siphonobranchiata*, of De Blainville's System of Malacology. This mollusc has its organs of respiration formed by two large and uniform comb-like branchiæ. The family includes the genera *Fissurella*, *Emarginula*, and *Parmophora*, all of which were blended by Linnæus in his genus *Patella*, from which they are quite distinct, except in general habits and some external resemblance.

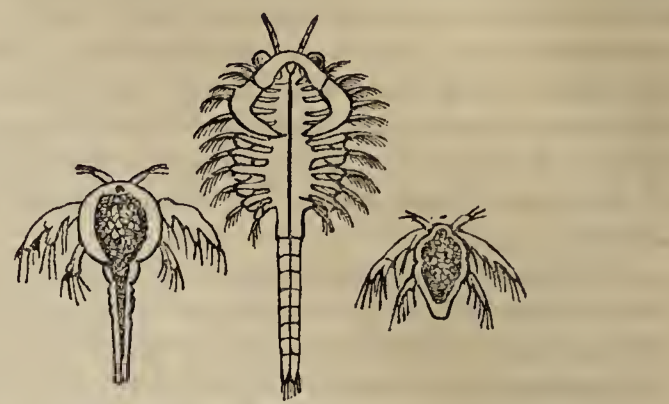
BRANCHIOPODA (Latreille). An order of the class *Crustacea*, and subclass *Entomostraca*, having for its characters, the mouth composed of an upper lip, two mandibles, a tongue, one or two pairs of maxillæ and branchiæ always placed anteriorly. These crustacea are always wandering in their habits, not being parasitic upon other animals, as is the case with the order *Pœcylopoda*. They are generally covered by a shield-like shell, or a case resembling a bivalve; they are furnished with two or four antennæ; their legs are formed for swimming, varying in number, some having only six, others from twenty to forty-two, whilst some have more than a hundred; many have but one eye. They formed in the system of Linnæus the single genus *Monoculus*, but a more precise study of these animals has proved that they present modifications in their structure much more striking than are to be found in the large *Decapod Crustacea*.

This order is divisible into two principal sections, first, the Lophyropoda, in which the number of legs never exceeds ten, with cylindric or conical joints; the branchiæ are few in number. Many have but one eye, and the antennæ, which are generally four in number, are employed as locomotive organs. Latreille divides this first section into three principal and very natural groups. 1. The *Carcinoida* have the shell oval or ovoid, not bivalve, the legs are ten in number, and the eggs are borne by the females in two large external sacks on each side of the base of the abdomen (Cyclops, &c.). 2. The *Ostracoda* (Latreille; *Ostrapoda*, Strauss), having a bivalve shell united by a hinge, and closing during repose; the antennæ are simple and setaceous. They have six legs and only one eye, the mandibles and upper maxillæ are furnished with a branchial plate (Cypris, &c.). 3. The *Cladocera* (Latreille), having also the shell bivalve and a single eye, but without a hinge, and terminating in a point behind, with the head, which is covered by a shield-like plate, exposed; the antennæ are two in number, very large and branched. They have ten legs (Daphnia, &c.).

The second principal section of the branchiopoda is named Phyllopoda, from the legs, which vary in number from twenty to more than a hundred, being flattened, the joints forming ciliated plates. They have a pair of eyes, and the antennæ, of which there is generally only a single pair, are small and not fitted for swimming. This section is divided into two principal groups. 1. The *Ceratopthalma*, having the eyes generally carried upon footstalks, ten or twenty-two pairs of legs, the anterior neither much longer than the remainder nor branched. The eggs are either internal or carried in a sac at the base of the abdomen (*Limnadia. Branchipus*). 2. The *Aspidiphora*, having sixty pairs of legs, all furnished at the base with a vesicle, the anterior very large and ramose, three sessile eyes, with two bivalve capsules enclosing the eggs, and attached to the eleventh pair of legs (Apus, which see). It is to be observed that the subdivisions of this order have been regarded by Messrs. Strauss, Edwards, and some other authors, as separate orders.

BRANCHIPUS (Latreille; Chirocephalus, Jur.). A genus of crustaceous animals belonging to the order *Branchiopoda*, section *Phyllopoda*, and group *Ceratopthalma*. In this remarkable genus the eyes are placed at the extremity of footstalks, the body is narrow, long, and compressed, the head distinct, with two horns between the eyes, eleven pair of legs, the abdomen long and cylindric, with two terminal ciliated plates. The males are distinguished by a pair of very large horns attached to the mouth. The eggs are borne by the females in a pouch attached to the base of the abdomen. Jurine, Prevost, and Dr. Shaw have given very full accounts of the structure and habits of these animals, of which we have met with one of the species, which are few in number, in standing water, near Turnham Green. When full grown they are about an inch and a half long, and are found occasionally in great numbers in small puddles of standing fresh water; indeed, like the species of apus, they are often to be observed in water collected after heavy rain, especially in spring and autumn. They swim well upon their backs, and their legs, which are incapable of assisting locomotion, are kept in constant undulatory movement, which has for its object the forming of a current of water between the base of these organs, and which, following the canal of the breast, conveys to the mouth the small particles upon which the animal feeds. Its movements are caused by repeated jerks of the tail; so that when swimming upon its belly it appears just like a small fish. The eggs are yellowish coloured; they are at first round, but afterwards assume an angular form, which favours their preservation, since it appears that they are enabled to withstand a very considerable degree of drought until a fall of rain sufficient to cause them to hatch takes place. The females deposit their eggs at different times to the number of from one to four hundred at each time. On quitting the egg the body is divided into two globular masses, the anterior of which comprises a single eye, two short antennæ, two large branched organs serving for swimming, and two short and slender legs. After shedding their skin the first time, they have three eyes, the middle one being smooth; the hinder part of the body is elongated, and the tail is terminated by two short filaments. Subsequently the legs begin to appear by degrees, and the branched organs entirely disappear.

Dr. Leach established a genus intimately allied to the preceding under the name of *Artemia*, for the reception of a small but interesting species, of which an account was first given in the eleventh volume of the Linnæan Transactions, by Mr. Racket, and named by him *Cancer salinus*, or the brine shrimp. During



Brine Shrimp.

the past year (1834) Mr. J. V. Thompson has published a very interesting notice of it in his Zoological Researches, accompanied by numerous figures. The body is oval, and flattened, with the head not separated from it; the tail or abdomen is long, terminated by two small points. "The brine shrimp, or *Artemia*" (not *Artemis*, as Mr. Thompson, from whom we quote the following observations, calls it) "*salinus*, is a very small and delicate animal; when full grown about half an inch in length, of considerable transparency, slightly tinged with yellow, and with a highly polished surface; nature having constructed them with members solely adapted to swimming, they seem to be in perpetual pursuit of prey, gliding with an almost even motion through the water, and moving with equal indifference and facility on the back, belly, or sides; the shape of the animal, the undulating movement of its fins, and the glossy appearance of its coat render it an object of a very interesting description, more especially when apprised, that analogous animals appear to have been the first created conspicuous inhabitants of the primitive fluid, of which these may be regarded as a degenerate or pigmy race. Hitherto the only localities in which these little animals have been observed are some salt lakes in Siberia, and the salt-pans at Lymington, Hampshire; in these situations, however, they occur in the greatest abundance; and at the last named place, making their appearance in the early part of the spring, multiplying beyond conception during the summer and autumn, and disappearing during the winter months, a phenomenon common to many of the smaller crustacea. As in all salt-works the pits have different distinctions, it must be observed that they are not found indiscriminately in all, but principally in the tanks, called clearers, in which the brine acquires such strength as to furnish four ounces of salt to the pint measure; by the account with which Mr. Racket has favoured us, it would appear that the workmen attribute to them the property of assisting in the clearing of the brine, and hence transport them to such tanks as seem to be without them. How they came originally to the salterns at Lymington, and what animalcula live in so strong a solution to afford them food, must be left to future investigators placed under more favourable circumstances." Mr. Thompson has traced the gradual development of these curious animals, which nearly resemble those of the branchipus.

BRASSIA (R. Brown). Named in honour of W. Brass, a botanical collector. It belongs to the curious order, *Orchideæ*, and is one of the most beautiful of the tribe. The two species at present known are, *B. maculata*, has large pale yellow flowers; spotted with brown; *B. caudata* has similar flowers, with long tails to their lower segments. This last was called *Epidendrum caudatum* by Linnæus.

BRAZIL NUT is the *Bertholetia* (L. C. Bertholet, a chemist) *excelsa* of Humboldt. It is a lofty-growing tree, common about Para, in South America, and yields those nuts now very common in fruiterers' shops.

BREAD FRUIT is the *Artocarpus* (bread fruit) *incisa* (cut-leaved) of Linnæus. The flowers are monœcious, that is, males and females, separate on the same plant. The former is a cylindrical catkin. Calyx none; petals two; filament as long as the petals. Female flowers have neither calyx nor corolla; ovaries many, collected in a globe; style filiform; drupe compound. This tree, of which so much has been written, is found on the continent of India, and on the islands of the South Seas. The tree grows to a middling size at Malacca, and bears a round rough-skinned fruit, as large as a child's head. The skin is,

Artocarpa.

however, thin, and has a conical-shaped core, surrounded by a white farinaceous pith-like substance, which is the eatable part, after being roasted in thick slices: the taste is similar to that of a frosted potato. In this way it may be certainly used as bread, when nothing better can be had, but is far inferior to the yam (*Dioscorea sativa*), which is capable of being cultivated everywhere in those climates in which the bread-fruit tree appears. The fruit is ripe in December, and is dressed in various ways, according to the taste or convenience of the parties using it. The Dutch cooks improve it, by broiling or frying it in palm oil. Besides the use of the fruit, the natives of the South Sea islands apply different parts of the tree to various purposes. The wood is used in boat-building; a cloth is made of the inner bark. The male catkins serve for tinder; the leaves for wrapping up food, and for wiping hands instead of towels; and the juice for making cement for filling up the cracks of water-vessels. There are, according to Forster, several varieties of the bread-fruit. The principal of these is one without seeds. The natives of Otaheite reckon at least eight, differing in the form of the leaf and fruit.

In 1793, the bread-fruit was introduced to the West Indies by the unfortunate Captain Bligh, and subsequently to other tropical parts of the American continent. It has not, however, answered the expectations of those who advised its introduction to those countries, as an article of negro food.

The *A. integrifolia*, or Jaca-tree, is supposed to be only a variety of the incisa, because its leaves are sometimes divided; but the trees are very different when seen growing together. The incisa is a low spreading tree, very much like a common standard fig-tree; whereas the integrifolia grows more upright, assuming a conical-formed head, though the lower branches rest on the ground. The fruit are produced at the points of the twigs or branches, and, from their weight, are often seen resting on the ground. Sometimes it happens that they fall into the cracks caused by drought, and they ripen, raising up the soil round them, and to greater perfection, it is said, than if ripened in the air. When such fruit are taken, they require to be dug up; hence the report that the tree bears fruit upon the roots! Both kinds of the bread fruit are met with in British collections, and are propagated by "making stout, well-ripened cuttings, placed in pots of sand plunged under a hand-glass in moist heat."—*Sweet.*

BREAD-NUT is the *Brosimum* (good to eat) *alicastrum* of Swartz, a genus of two species of evergreen shrubs, natives of Jamaica. The flowers are polygamous, and belong to the natural order *Urticeæ* The leaves and young branches are full of gum, and are used as food for cattle. The fruit, either boiled or roasted, is sometimes used by the negroes, and the poorer classes of white inhabitants, in times of scarcity, and is said to be highly nutritious, resembling in some degree roasted Spanish chestnuts.

BREAM (*Abramis*, Cuv., *Cyprinus*, Lin.). A genus of soft-finned fishes, belonging to the division which have abdominal fins, and to the carp family CYPRINIDEÆ, which see for the general characters and habits of the family. The general characters are: no spines on the body, and no beards or filamentous appendages. The dorsal fin short, and placed behind the ventral ones. The anal fin long. There are two species known with us, the common bream, and the little bream, the first of considerable value as an esculent fish, the second of comparatively little. There are also two or three species, but generally speaking, of small value or interest, which seasonally ascend the rivers which discharge their waters into the Baltic, and there are also some in India, and in other parts of the world. They are, properly speaking, fresh water fishes, and they prefer deep and still waters, as lakes, and the pools of slow running rivers. The common bream is found in many of the lakes and rivers of England, and in some of the more southerly parts of Scotland, as in the waters of Lochmaben; but it has not been found in the north of that country, where lakes are more numerous and deeper. If there is sufficient depth of water, they breed freely and thrive well as pond fishes.

BREEZE FLY. A term of very indefinite signification, employed to designate such dipterous insects as attack cattle and horses, causing them to exhibit violent signs of alarm, such as running and tossing themselves about. These symptoms are produced by various insects belonging to two different families, for both of which the term has been employed in common with another, equally indefinite, that of Gad-fly. The family *Tabanidæ* produce these effects by sucking the blood of the animals, which they cause to flow by wounding the skin by means of the powerful lancet-like apparatus of their mouths, whilst the *Œstridæ* instil terror into the cattle, not by wounding them, but by the instinctive dread which they cause during the act of depositing the eggs, the grubs from which, when hatched, burrow beneath the skin. As it is impossible to assign these vernacular terms to either one or the other groups with any thing like precision, it will, perhaps, be safer to describe the insects under their scientific names. Some of the *Œstridæ*, however, being sufficiently distinguished by their name of Bot-flies, we have described them under that name; the remainder, with the *Tabanidæ*, will therefore appear in their places.

BREMONTIERA (*Decandolle*), named in honour of M. Bremontier, an eminent agriculturist. It is a leguminous shrubby plant, introduced from the Mauritius. It is also called sand-wood.

BRENTHIDES (Schonherr). A division or sub-family of coleopterous insects, belonging to the great family of the Weevils (of which Schonherr enumerates more than three thousand species) and to the section *Orthoceri*, or those having straight antennæ. The rostrum is long and porrected, especially in the males; the body is very long, cylindric, and narrow, and the neck is distinct. The type of the division is the genus *Brentus* of Fabricius, and the *Curculio anchorago* of Linnæus may be cited as an example.

These insects are peculiar to hot climates, one species only being found in Europe. namely, the *Arrhenodes coronatus*, Germar (*Brentus italicus*, Dej.) It is a remarkable circumstance in the geographical distribution of insects, that this Italian species is the only one belonging to the genus *Arrhenodes* found in the old world, the remaining species of the genus being inhabitants of South America, where they are the only species of the sub-family, *Arrhenodes coronatus*, according to information given to Latreille by M. Savi, and which has been confirmed to us by one of the sons of Mr. Spence, who captured many specimens of these insects in Italy, resides beneath the bark of trees, in the midst of the nests of certain species of ants which establish their abode in such situations. M. Lacordaire also made the same remarks relative to the Brazilian species, and we have been informed by a gentleman, recently returned from an Entomological tour in North America, that the *Brentus maxillosus* burrows beneath the bark of the trees which form the Corduroy roads in the back settlements.

This sub-family comprises eight genera, and about seventy species, in the system of M. Schonherr.

BREVIPENNES (*Short-quills*). The first of the five families into which Cuvier divides his "*échassiers*," or birds which depend for their locomotion, at least when they are seeking their food, more upon the foot than the wing. The genera which are included in the present family are all dry land birds, inhabiting warm, and, generally speaking, dry countries. The *ostrich* of Africa, the *rhea* of South America, the *cassowary* of the south-east of Asia, the *emu* of Australia, and the *apteryx* of New Zealand, are the only known genera. They will be found described under their common generic names; and some general notice of the family will be found in the article BIRD.

It may not, however, be irrelevant here to remark with what accuracy Cuvier chooses the names for his divisions of animals, and that this is nowhere more remarkable than in the two divisions of birds which are characterised by the shortness of their wings, *brachyptera* and *brevipennes*. The former have the wings short, some of them too short for being at all useful in flight; but even in these cases they are still very perfectly formed wings in their bones, their articulations, and their feathers—more firm, compact, and powerful, indeed, than those wings which are used only in the air, and therefore better able to resist the water, in which they act as fins. In the *brevipennes*, again, there is no part of the wing capable of acting powerfully even in the air; there are no quills, and the organs of motion are capable of doing little more than extending the wing from the side, so that it acts as a balance to the body as the birds run along, which most of them do with very considerable swiftness. These birds have motion on land only, and in that motion they carry the axis of the body horizontally, or nearly so; while, when the brachyptera are on land, they must carry the axis nearly vertical.

BREXIA (*Brexis*, rain; leaves protect against), so named by Noronha. A genus of three evergreen trees, from Madagascar and neighbouring islands. They belong to *Pentandria Monogynia* of Linnæus, and form an order of themselves in the natural system. Generic character: calyx short, with five rounded lobes; petals ovate, spreading, rounded; filaments dilated at the base; bristles round the seed-vessel shorter than the stamens. These are fine hot-house plants, with firm, jagged, shining leaves, having flowers produced from the stems. These plants are allied to *Theophrasta*.

BREXIEÆ. A natural order of dicotyledonous plants, containing only a single genus and three or four known species. It is nearly allied to the *Rhamneæ* and *Celastrineæ*, differing from these orders chiefly in its hypogynous stamens and indefinite seeds.

The essential botanical characters of the order are, calyx five-partite, inferior, persistent; petals five, hypogynous; stamens five, hypogynous, alternate with the petals; anthers oval, two-celled, bursting longitudinally; pollen triangular, united by means of fine threads; ovary superior, five-celled; one style; fruit a five-celled, many-seeded drupe.

Brexieæ.

The plants belonging to this order are trees with simple trunks and coriaceous alternate leaves. The flowers are generally of a green colour, and grow in axillary umbels. They are found in Madagascar and Mauritius. Their properties are as yet unknown.

Brexia is the only genus. *Brexia Madagascariensis* is a rare and curious tree-like plant found in Madagascar. Its leaves when in a young state are very long and furnished with prickly teeth, but when full-grown they become ovato-oblong, and the teeth nearly disappear. *Brexia spinosa* is commonly known in gardens by the name of *Theophrasta*.

BROCCOLI. The *Brassica oleracea*, variety *Botrytis* of De Candolle. A highly valued variety of the cabbage family, cultivated for its imperfect flowers as a table vegetable. Broccoli, its Italian name, is supposed to be a sport (as florists call such variations) from the cauliflower, as this last is mentioned in history before the former. When first employed in this country as a table vegetable, it appears to have been used in the state of sprouts rather than in large substantial heads, as it is now brought to table; because it was trimmed and bundled by the cook exactly like asparagus ; hence it was called Italian asparagus, and in botanical books, it is to this day designated *asparagoides*, as a specific distinction. It differs from cauliflower in habit and colour, both of leaves and flowers, when fit for use; and is also more hardy and keeps longer in season.

Cultivation.—The chief objects of the cultivator are to obtain a supply for the table in every possible season, and to grow it to the largest possible size. The first is gained by timely sowing, proper treatment of the seedlings and subsequent management; the second by a due preparation of the soil they are ultimately placed on, by deep digging or trenching, and sufficient manuring. The last particular is indispensable to insure fine broccoli, as the plant is a "gross feeder," and therefore requires abundance of manure, and to be placed on a naturally rich soil. As broccoli is required and may be had from the end of August till nearly the same period in the following summer, sowings must be made consecutively to be transplanted in successional order. The first sowing is made about the 15th of April, and continued weekly till the 1st of July. The seed beds should be in a perfectly open situation, rich, light, and finely broken. Similar beds must be got ready, on which the seedlings are pricked out five or six inches apart, as soon as they have three or four leaves.

The use of transplanting seedlings from the seed to a nursery bed, is for the double purpose of thinning the seed bed, and giving the removed plants a more stocky habit. For the sake of getting very stout plants for final transplanting, some gardeners transplant them twice; others do not prick out into nursery beds at all, but place them out at once from the seed bed; others again sow the seeds where the plants are to remain for good. This last practice requires too long an occupation of the ground, and often much trouble in filling up blanks, or replacing such as turn out any way defective. The Cape varieties grow rapidly, and yield heads sooner than the old sorts; of course they do not require pricking out so much as the latter.

Those portions of the garden usually appropriated to the cultivation of broccoli is that which has borne a spring crop, such as spinach, early peas, or other crop that comes off during June, July, or August. After being cleared of weeds, a coat of good, rich, moist dung is spread thereon and well digged in; it is then ready to receive the plants drawn from the seed or nursery beds. The plants are dibbed in rows at distances according to the growth of the variety, or the time of the year when planted. Late plantations of the dwarf sorts require less space than the large growing kinds. Full and free air is necessary for all; The small varieties should not be put in nearer than two feet between the rows, and twenty inches apart in the rows. The large sorts at three or four feet intervals between the rows, and two feet distances plant from plant in the rows. The plants should be dibbed in as deep as the lower leaves, and water should be immediately given if the soil be dry and the weather warm. The after management consists in keeping the ground well, and frequently hoed among the plants to admit air and destroy weeds; and when the plants advance in height, mould should be drawn to the stems to keep them steady in their places.

Broccoli is liable to be killed in severe winters. To prevent such injury, different expedients are had recourse to for its preservation. When the winters were more severe than they have been lately in this country, a usual practice was to lay it down. This was done about the 1st of November, or earlier if the weather was threatening. Two men do this most expeditiously: an opening is first made at the north end and close to the end plant of the first row, the removed earth is laid on the opposite side of the opening, forming a bank on which the head of the plant is to lie; both spades are then entered behind, deep enough to undermine and move the whole ball of earth containing the roots, and which, plant and all, is whelmed half over till the plant lies on its side, the head facing the north. The firm ground between the first and second plant is digged over upon the stem, which should be well covered to be quite safe from frost; as this part is the first to suffer. An opening being thus left for the second plant, it is laid down as the first, and so on to the end of the row. In this way of laying down broccoli, it is supposed that the rows point south and north; but if they are planted in any other direction, the plants may be laid in the proper position nevertheless. The reason for laying the heads toward the north, is, because in winter sunshine, the heart or bosom is melted, and if followed by a frosty night the thawed parts are sure to suffer; whereas, when laid facing the north, they are less likely to be injuriously affected by a change of temperature. There are other schemes practised for preserving broccoli; instead of laying it down when it grows, the plants are taken up with as large balls of earth as will adhere to them, and removed into vacant pits or frames where they can be plunged closely together, and covered with glass-lights or mats when necessary. Or by plunging them closely together in the open air, and on beds of moderate width and hooped over, they may be preserved from frost by mats, pea-straw, or dry fern. By such means broccoli may be had for the table throughout the severest winters, and well repays every care bestowed upon it. In private gardens, and on a small scale, such precautions should never be omitted; when cultivated extensively, as in market gardens, laying it down where it grows, as above described, is the only plan that can be followed. Indeed, for these five or six winters last past, no precautions whatever have been taken to preserve broccoli, and little loss has occurred, owing to the mildness of the winters.

What are called Cape varieties, introduced about thirty years ago, are a great acquisition. The sorts previously in cultivation, though good in favourable seasons and under proper treatment, all came in too closely together, so that there was either none at all to be had, or for a time too much. But the Cape varieties, particularly that excellent one called "Grainger's," are earlier; good heads being sometimes cut in August from plants raised from seed sowed in April. Indeed it has been proved that, by choosing the proper seasons for sowing, and giving necessary care in the culture, the heads may be had in perfection at any time. The Cape sorts are least valuable from the middle of May to the end of June, because cauliflowers are in season, and generally preferred to any kind of broccoli.

There are nearly twenty varieties in cultivation, and treated so as to succeed each other, with reference to their hardiness, or time of coming into use. Some sorts yield heads in about four months; others require six; and several remain ten or eleven months from the time of sowing before they show flowers, although they may be all sowed at the same time, viz. about the 20th of April.

The market gardeners in the neighbourhood of London, who in the cultivation of every culinary plant excel all others, have determined the characters, value and properties of the various sorts of broccoli, and have arranged them according to the order in which they come into use, viz.

1. Autumnal purple Cape. *
2. Autumnal green Cape. *
3. Grainge's cauliflower, Cape. *
4. Winter green Cape. *
5. Common early purple.
6. Early white.
7. Early brown.
8. Tall purple common. *
9. Cream coloured. *
10. Sulphur coloured. *
11. Spring white.
12. Late dwarf.
13. Siberian, or latest.

N. B. Those marked thus * are tall growers.

Some of these varieties have close compact heads, which, when cut, are not succeeded by sprouts; others have long branched heads, which when, the topmost is cut, send forth numerous shoots bearing smaller heads from the axils of the lower leaves. Of this description is the early purple and some others; proving very useful in those seasons when the uppermost flowers happen to be killed by frost.

BRODIÆA. Named in honour of J. Brodie, a cryptogamist, by Sir J. Smith. A family of small bulbous plant, introduced from various parts of America. They belong to *Hexandria Monogynia* of Linnæus, and to the natural order *Hemerocallideæ*. They are curious little plants, bearing bunches of blue flowers, and usually cultivated in frames, or in the green-house.

BROME GRASS is the *Bromus* (Greek name of wild oats) of Linnæus. A family of grasses chiefly European, containing forty-seven species, of which twenty-seven are annuals. Twelve are natives of Britain, and occur on every hedge bank. The *B. secalinus* is too often met with in wheat crops; and as the seeds are large and heavy, are not easily separated from the wheat, in which, if the *ray*, as it is called by farmers, appear, a lower price is given. The seeds of this species of grass are far from being deleterious in bread, though the reverse is erroneously asserted: on the contrary, both the quantity and quality approach very nearly to the smaller varieties of oat. Indeed, for the purpose of feeding poultry, the *B. secalinus* or ray-grass, is well worth cultivation; for if sowed in October, it yields a bulky crop in the following summer, ripening along with the wheat. As a pasture or forage grass, it is however of no value, as the radical leaves are few in number, and the stems rigidly hard; and being an annual, is too fugitive for grazing purposes. The *B. giganteus*, with its two varieties, the *triflorus* and *longifolius*, being perennials, are admitted among others in laying down meadows. It is said that the panicles, cut before the seeds are ripe, have formerly been used to dye green. The seeds of the *B. mollis* are said to be fatal to poultry: if this really be so, geese are not included, as they will eat nothing else, if the seeds of the soft brome-grass is within reach; hence it is provincially called goose-grass. The *B. asper* is the tallest of British grasses, and often met with on the margins of moist woods.

BROMELIACEÆ. The pine-apple family. A natural order of monocotyledonous plants containing upwards of a dozen genera, and more than a hundred species. The order is allied to the *Commelineæ*, *Xyrideæ*, *Amaryllideæ*, and *Hydrocharideæ*. Its essential characters are, calyx three-parted or tubular, more or less cohering with the ovary, persistent; petals three, coloured, withering or deciduous; stamens six; ovary inferior, three-celled, many-seeded; style straight, terminated by a three-lobed, often twisted stigma; fruit capsular or succulent, three-celled, many-seeded.

The habit of this order is peculiar, and few families are more interesting from their beauty and singularity. The plants belonging to the order are parasitic, perennial, and either stemless, or furnished with very short stems. They have hard, dry channelled leaves, generally with a downy surface, sometimes minutely scaly, and provided with spines. Their rigid calyx is strongly contrasted with their delicate white and blue petals. They are generally acid, and sometimes yield an edible fruit. They are natives of the hotter parts of America, whence they have been spread over Africa and some parts of the East Indies.

The chief genus, and that from which the name of the order is derived, is *Bromelia*, a name given by Linnæus in honour of Olaus Bromel, a Swede, author of several botanical works. *Bromelia ananas* or *Ananassa sativa*, the common pine-apple, is well known to every one on account of the richness and fine aromatic flavour of its fruit, which is esteemed the finest in the world. The plant is originally from Brazil, whence it passed to the West and then to the East Indies. About the middle of the seventeenth century it was brought to Holland, and from that country it was introduced into Britain in the year 1690. It is now cultivated more successfully in this country than in any other part of Europe.

The name pine-apple is derived from the circumstance of the fruit being covered on all sides with small triangular scales, resembling the cone of a pine tree.

Many varieties of pine-apple are known in the West Indies, and upwards of thirty sorts are cultivated in this country. Thus we have the Queen Pine, New Providence, Brown Sugar-loaf, Striped

Sugar-loaf, Montserrat, Antigua, King Pine, Green Pine, &c. Of these the two first are perhaps the most esteemed. The white or queen pine is the most common in Europe, and is the most to be relied on for a certain and good crop.

Pine apples seldom perfect their seeds in this country, and hence they are propagated by suckers, which appear on the fruit stalks or proceed from the base of the plant, and by crowns or tufts, those peculiar productions which grow on the fruit. The suckers, after they have assumed a brownish colour, are removed from the plant, by breaking down the leaf beneath them and then moving them gently backwards and forwards till they fall off. The crowns are generally returned to the gardeners after the fruit has been presented at table.

The culture of the pine apple is very expensive and troublesome. Fruit is seldom produced till after the lapse of two or three years. A *bark-pit* is used for nursing the crowns or suckers, the plants are then transferred to a low stove called a *succession pit*, where they are kept till they are ready for fruiting; they are then removed to the *pine-stove* or *fruiting-house*. In order to secure good pine apples, plenty of room must be allowed to the plants in the nursing and succession pits, so that the lower parts of them may swell out and increase in bulk. Mr. Knight says that a loamy soil, well enriched with rotten dung, and the pots sufficiently drained, with abundance of heat without sudden extremes, will ensure large and well flavoured fruit.

Pines should be watered sparingly in dull weather, more especially in winter, from the beginning of October to the first or middle of March. After that, plentiful waterings may be given every three or four days. Fruiting plants ought to receive plenty of water from the time they go out of flower till they begin to colour. When they approach maturity, water should be applied more sparingly, inasmuch as by this means the flavour of the fruit is increased. The fruit is generally ripened from the month of June to September, and is known to be perfect by its acquiring a fine golden colour and a delightfully fragrant smell. The fruit is eaten in greatest perfection soon after being cut. It may be preserved, however, for several weeks, by putting the stem into a bottle of pure water, renewed every two or three days, and placed in a well dried room at the temperature of 60° Fahrenheit.

In some of the East India islands pine-apples are said to be so abundant at certain seasons of the year, that the inhabitants clean their swords by running them through the fruit.

A juice is obtained from the pine-apple, which by fermentation yields a liquor possessing stimulating and diuretic properties.

Pines are subject to injury from the attacks of brown and white scaly insects of the coccus tribe, as well as from the ant.

Bromelia pinguis which is common in Jamaica, has its fruit separately in clusters, and not in a cone or pine. On account of its prickly leaves it is used for inclosing pasture lands. It also yields a kind of thread used in the manufacture of cloth and in the formation of ropes. The juice of the fruit is said to be diuretic, and when mixed with water forms a cooling drink in fever and dysentery. A vinous liquor is also procured from it.

Bromelia medicaulis is chiefly valued on account of its showy blossoms. Its leaves, like those of the common teasel, retain a considerable quantity of water in their folds, and thus afford a delicious drink to the traveller in the scorching climates in which the plant grows.

Bromelia fastuosa is the most beautiful species of the genus. It has rarely flowered in Britain.

Tillandsia is another genus of this order, which deserves to be noticed on account of the peculiar mode in which many of its species grow. The name is given in honour of Elias Tillands, who was born in 1640, and died in 1692. He was keeper of the botanic garden at Abo, and paid much attention to the botany of Finland.

Tillandsia utriculata, bladder Tillandsia, is a valuable parasite found in the woods of the West Indies. Its seeds are feathery, and being carried along by the wind, adhere to the bark of trees. In this situation they take root, and send forth leaves which grow in such a way as to form at their lower part a deep hollow basin, capable of containing a quart of water. The upper part of the leaves is narrowed, so as in some measure to close the mouth of the basin, and thus prevent the rapid evaporation of the water. Thus even in warm countries a reservoir of water is obtained, whence man and animals draw a welcome supply. The water seems to be destined for the support of the plant during drought. When the stem of this plant is wounded, a clear white gum is said to exude.

Tillandsia usneoides, long-moss Tillandsia, is found in shady woods from Virginia to Florida, as well as in the West Indies and Brazil. It vegetates on the black mould that collects on the bark of the ebony and other trees in hot damp countries, forming dense festoons, which hang from the branches in a most graceful and elegant manner. The slender thread-like hoary stems of this parasite are so twisted together, as to secure for them in Jamaica the name of Old Man's Beard. When the hoary bark of this singular parasite is separated by beating or rubbing, the remains of the stems look like a mass of curled horse-hair, and are used by sadlers and coach-makers for stuffing pannels and cushions. They are also employed in Louisiana for making mattresses. The hanging nest of the Bonana bird is made from the fibres of this plant.

Tillandsia stricta, frosted stiff-leaved Tillandsia, is cultivated in this country, and blossoms freely when suspended by a thread in a warm room. When hung up in a green-house during our winter without the application of any artificial heat, the plant decays, but can be made to revive again in spring. It can thus be made to endure an artificial winter. This is not the case with many of our exotic parasites. *Caraguata ligulata,* is found on old trees in the vast forests of Martinico and of Jamaica. Its leaves, like those of *Tillandsia usneoides,* are said to collect water in the rainy season.

Other species of this genus, with their spiny leaves, form an impenetrable herbage in the pampas of Buenos Ayres and Brazil. Many of the Tillandsias are favourites in the gardens of South America. They are suspended in houses and hung from balconies, throwing out a profusion of flowers, and diffusing a delightful fragrance. From growing in the air without any attachment to the soil, they have sometimes been denominated air plants. See article Air Plants.

The species of *Pitcairnia*, another genus of the order, are readily cultivated in almost any soil in a good stove. They thrive best when plunged in a tan-pit, and allowed to root through their pots into the tan. Tillandsia and Pitcairnia differ from bromelia, in not having the germen completely inferior.

The genus *Agave* belongs also to this order. *Agave Americana*, or American aloe, is a popular succulent plant throughout Europe, which is acclimatised in Sicily, the south of Spain, and Italy. Proper cultivation is required in order to make it flower freely and speedily. It is used for various purposes, as for making ropes, fences, soap, &c. From the *Agave Mexicana* a spirituous liquor is obtained, similar to Scotch whiskey. For a full account of the genus, see article Agave.

Several bromelias are now included under the genus *Billbergia*, *Billbergia iridifolia*, drooping *Billbergia*, is found parasitic on trees at Rio Janeiro. Its seeds take root both on branches of trees, and on stones covered with decomposed vegetable matters.

In general the pine apple tribe are found in situations where the atmosphere is humid, and where at the same time the temperature varies from 70° to 90° Fahrenheit. Hence, in cultivating them in this country we ought particularly to attend to these requisites, if we wish our attempts to be crowned with success.

Among the other genera belonging to this order we may enumerate, *Buonapartea*, *Litlœa*, *Guzmannia*, *Pourretia* and *Caraguata*.

BRONTES (Fabricius, Uleiota, Latreille). A genus of coleopterous insects, placed by Latreille amongst the *Tetramera*, and belonging to the family *Cucujidæ;* the antennæ are long and cylindric, with the third and following joints of equal length; the palpi are slender at the tips. The type of the genus is the *Brontes flavipes*, an European species, of which the male is remarkable for a large pair of horns, with which the back of the mandibles are armed. It is found beneath the bark of trees.

BROOK LIME is the *Veronica beccabunga* of Linnæus. The specific name is derived from the German *bachbunge*, because it is found in brooks. The plant is frequently seen growing along with water-cresses; and, like them, is used as an ingredient in salads.

BROOK WEED is the *Samolus* (pig's meat, Celtic) of Linnæus; a genus of three species of herbaceous perennials, one of which is the brook-weed of Britain. It is a pentandrious plant, and belongs to the natural order *Primulaceæ*. The *S. valereandi* has white flowers in clusters, and found in clear watery places where the soil is gravelly.

BROOM is the *Spartium* (cordage, its use in early ages) of Linnæus, and in his time was a very extensive genus, but is now very much divided by modern botanists, and distributed among the neighbouring genera of *Genista* and *Cytisus*, so that there is only one species of broom left, viz. *Spartium junceum*, the rush-stemmed or Spanish broom. The old common broom of our wastes, one of the most ornamental of British plants, formerly so much used for domestic purposes, as for besoms, thatch binders, and as a substitute for hops as well as medicine, is now no longer a *Spartium*, but the *Cytisus scoparius* of Lamarck.

BROOM RAPE is the *Orobanche* (strange vetch) of Linnæus, a very curious genus of plants, and natives of Britain. They are didynamous, and form a natural order of themselves, viz. *Orobancheæ*. The generic character: calyx of two-lobed lateral leaflets; corolla gaping; capsule one-celled, two-valved, many-seeded; a gland at the base of the ovary. There are six species of this genus, all of which are said to be parasites, that is, living on the roots of other plants, chiefly on those of the order *Leguminosæ*. The *O. major* is met with in great plenty on the roots of the common red clover, in light sandy or gravelly soils, making its appearance along with the second crop. Its roots spread themselves on those of the clover, forming a kind of bulb, and sending up a leafless stem resembling the shoots of asparagus, when they first emerge from the ground. The stem rises to the height of from eight to fourteen inches, having alternate, bracteous scales along its whole length, and also among the flowers, which are borne in a spike at the top. The plant has always a brown withered appearance; the stem and flowers showing only a slight tinge of red or purple. From it so uniformly accompanying the clover, it has long ago occurred to the writer whether it be sown with it. The second crop of clover is usually saved for seed, and with this the broom-rape appears. There is no sign of it attacking the plant during the first twelve months of its existence, nor indeed till it is fifteen or sixteen months old. In other words, the clover is sowed in the month of April; it remains till the month of June in the following year, before it is cut the first time: the second crop is ready about Michaelmas in the second year, and in this the broom-rape appears. Clover seed is always, as already observed, saved from the second crop: the plant which we are noticing is cut and carried to the barn therewith: the whole is thrashed together, and as the seeds are nearly of a size, they may be sacked up, and of course sowed together. This idea is the more reasonable, because the plant is never seen on arable land, but among clover: and there is no accounting for its presence, but by saying that the seeds lie inert in the soil from one clover crop to another, that is, for four or five years, or supposing that they are sowed together. The same plant is met with on commons or on borders of fields, among broom or furze; but is never seen in such quantity as among clover. Other species are found on the roots of other plants, but which will be adverted to under the article *Orobancheæ*.

BROSCUS (Panzer). A genus of coleopterous insects, separated from the Linnæan genus *Carabus*, and comprising a single British species, the *Carabus cephalotes* of Linnæus. The thorax is very much narrowed behind, and remote from the elytra, which are narrow and oblong; the head is large and nearly orbicular, and the anterior tarsi of the males have the three basal joints dilated; the mentum is deeply notched, with an obtuse central tooth. The typical species above mentioned is nearly an inch long, of a black colour, and is found beneath marine rejectamenta on several parts of our coasts.

BROSMIUS (*Tusk*), a genus of soft-finned fishes, with the abdominal fins under the pectorals, and belonging to the exceedingly numerous and valuable family of Cod (*Gadoideæ*). The tusk is a fish of the northern seas, being rare on the coasts of the mainland of Scotland, and more abundant at Shetland than Orkney. Like most of the family which inhabit high latitudes, it is rather hard and harsh in the recent state; but when salted and dried it is a valuable fish to those northern people who depend chiefly on the sea for their food, though it is far inferior to ling both in size and in quality. It grows to the length of about two feet, is dusky on the back, dull yellow on the sides, and white on the belly. The fins have white margins, and the pectorals and tail are rounded off at their extremities. The lateral line is a little curved; the body, from the vent to the caudal fin, compressed; and there is a plait or furrow on the neck. It is found on the same banks which are frequented by cod and ling, and taken by the hook in the same manner. This fish has sometimes been confounded with the *Torsk*, which is a species of cod, but it does not appear to be met with on any part of the British shores. See the name of the family for the characters and differences of the whole.

BROSSÆA. (G. de la Brosse, physician to Louis XIII., and founder of the Jardin des Plantes at Paris), so called in honour of, by Linnæus. There is only one species, a hothouse evergreen shrub, having scarlet flowers, and it is but imperfectly known to British botanists.

BROTULA, a genus of fishes belonging to the cod family, and bearing, in some of its characters, a slight resemblance to the tusk, but having the dorsal and the anal fins united, and forming the caudal, which terminates in a point. There is only one species known; it has six beards or filaments on the head, and is a native of the West Indian seas.

BROUGHTONIA (R. Brown). An orchideous plant, native of Jamaica, having fine scarlet flowers. It is said to be rare in British collections, in consequence of being difficult of cultivation.

BROUSSONETIA (Ventenat), named in honour of the French naturalist Broussonet. A genus of two species, said to be natives of Japan. The flowers are diœcious, and belong to the order *Urticeæ*. This plant was heretofore called *Morus papyrifera*, or Paper Mulberry, and is remarkable for the use made of its bark in the manufacture of paper by the Chinese, and of cloth by the Otaheitans. "The fruit is little larger than peas, surrounded with long purple hairs, when ripe changing to black purple colour, and full of sweet juice. In China and Japan it is cultivated as we do osiers, for the sake of the young shoots, from the bark of which the inhabitants make paper. The bark being separated from the wood, is steeped in water, and the inner bark separated from the outer, the former making the whitest and best paper. The bark is then slowly boiled, then washed, and afterwards put on a wooden table, and beaten into a pulp. This pulp being put in water, separates like grains of meal. An infusion of rice and the root of manihot is next added to it. From the liquor so prepared, the sheets of paper are poured out one by one, and when pressed and dry, the operation is finished. The juice of this tree is sufficiently tenacious to be used in China as a glue in gilding either leather or paper. The finest and whitest cloth worn by the principal people at Otaheite, and in the Sandwich Islands, is made of the bark of this tree. The cloth of the bread-fruit tree is inferior in whiteness and softness, and worn chiefly by the common people."—*Enc. of Plants*

We may here observe, that, notwithstanding the strongest objections made against the natural system have been raised on the apparent desociation of the order *Urticeæ*, yet, that there is a strong affinity cannot be denied, particularly in the instance of so many of the genera possessing the same tenacity of fibre. The common mulberry possesses so fine a web of silky fibres in its leaves, as has induced an experimental philosopher to conceive that the produce of the silk-worm is a vegetable, and not an animal substance.

BROWALLIA (Linnæus). Named in honour of John Browallius, bishop of Abo. A genus containing three species of tender annuals. The flowers are didynamous, and belong to the Jussieuan order *Scrophularinæ*. These plants are treated like other tender annuals, i. e. raised from seeds, sowed in a hot-bed in the spring, and afterwards potted or planted in the open borders, to flower in summer.

BROWNEA (Jacquin), named in compliment to Patrick Brown, M. D., author of a History of Jamaica. A genus of three species of splendid monadelphous plants, natives of the West Indies, and belonging to the natural order *Leguminosæ*. Generic character: calyx double; exterior sheath bifid, the interior funnel-shaped, five-cleft, and coloured; petals five, inserted in the calyx, longly clawed; stamens attached to the base of the tube; style filiform; pod flat and cimeter-shaped; seeds covered with fungous fibres. These plants are not yet very common in botanical collections; but, for the beauty of their flowers, they are well worth cultivation.

BRUCEA (Le Heretier). A genus of plants named to commemorate James Bruce, the Abyssinian traveller. They are ornamental evergreen shrubs, belonging to the class and order *Diœcia Pentandria*, and to the order *Terebinthaceæ*. There are three species; one a native of Abyssinia, where it was discovered by Bruce, the others natives of India.

BRUCHIDÆ (Leach). A family of coleopterous insects, belonging to the section *Tetramera*, and division *Rhyncophora*, nearly corresponding with the Linnæan genus *Bruchus*. The upper lip is distinct, the head is produced in front into a broad large and flattened snout; the palpi are very evident and filiform; the antennæ not clavate, but filiform or serrated, and the eyes notched; the elytra likewise do not conceal the extremity of the body. The larvæ of these insects are fleshy grubs, resembling those of the nut-weevil; they are produced from eggs deposited by the females in the tender germs of various leguminous or other plants, such as the palm, &c. These eggs are not hatched until the grains have acquired some size, so as to afford a sufficient supply of food to the inhabitant, until it is ready to assume its pupa state, which it does within the now hollow seed, out of which, when it arrives at the perfect state, it makes its escape by eating a small hole, the lid of which it detaches in the shape of a cap. It is an insect of the family *Bruchus granarius*, which destroys our peas, an egg being often deposited in every seed in a pod. Sometimes this vegetable is damaged to so great an extent, as to become unwholesome, as was the case in 1780, when the public authorities in France prohibited the sale of peas in the markets, being attacked by this or some similar insect. The *Bruchus Pisi* of Linnæus, in like manner, commits very great ravages in certain seasons in North America, so that the growing of pulse has even been occasionally abandoned as useless. Schonherr describes three genera, and upwards of one hundred and sixty species belonging to this family; of these seven only are inhabitants of our country.

BRUGMANSIA (Persoon). Named in honour of Professor Brugmans, a botanical author. It is a Pentandrious genus, and belongs to the natural order *Solaneæ*. Generic character: capsule spineless; calyx bursting at the side, persistent; corolla funnel-shaped, large; anthers glued together; stigma is a line running down each side of the style.

B. arborea.

B. arborea is one of the most ornamental hot-house plants, and withal one of the most fragrant. The flowers issue from the divisions of the branches, and burst from a loose tubular calyx, nearly four inches long. The corolla is large and trumpet-shaped; the lower part of the tube narrow, but spreading widely out at the mouth, where it is divided into five angles, terminating in long points. The flower is yellowish without, and pure white within; and its fragrance so powerful as to scent a whole conservatory. Being natives of Peru, the plants require stove treatment in this country, and in moist heat flower readily.

BRUNIA (Linnæus). A genus of twenty-four species of ornamental shrubs from the Cape of Good Hope, named in memory of C. Brun, a celebrated traveller. They belong to *Pentandria Monogynia*, of the sexual system, and give a title to the sixty-first order of Jussieu, viz. *Bruniaceæ*. The foliage of these plants being remarkably soft and attenuated, resembling some of the heaths, have always an elegant look, and are a fine contrast to plants of more ample and coarser foliage. Generic character: flowers

B. lanuginosa.

aggregate; calyx superior, five-parted; filaments inserted into the claws of the petals; stigma cloven; capsule small, and two-celled There is nothing reported relative to the virtues or uses of this tribe of plants: the previous cut represents a small twig of the *Brunia lanuginosa*.

BRUNIACEÆ. A natural order of dicotyledonous plants, containing nine or ten genera, and upwards of thirty species. Decandolle considers this order as nearly allied to the *Rhamneæ*, while other botanists think it approaches the *Hammaelideæ*.

The essential characters of the bruniaceæ are, calyx adherent with the ovary five-cleft, the segments often callous at the point; petals five, arising from the throat of the calyx, and alternate with its segments; stamens five, alternate with the petals; anthers turned outwards, two-celled, bursting longitudinally; ovary half adnate, one to three-celled; cells one to two-seeded; style simple or bifid; stigma simple; fruit dicoccous or indehiscent; seeds solitary, or in pairs, suspended, with a small embryo at the apex of a fleshy albumen.

The plants belonging to this order are branched shrubs, resembling the heaths and proteas in habit. Their foliage and flowers are very ornamental. They are furnished with small linear stiff leaves, generally in whorls. The flowers are small, and grow in heads, panicles, or spikes.

They are natives of the southern parts of Africa, and are found at the Cape of Good Hope and in the island of Madagascar. They are propagated chiefly by cuttings. Their properties are as yet quite unknown.

The genera are: *Brunia*, whence the order derives its name, *Staavia*, *Linconia*, *Raspalia*, *Berzelia*, *Berardia*, *Audounia*, and *Brunia*, so called in honour of Cornelius Brun, a traveller in the Levant and Russia towards the end of last century, is a pretty Cape genus, which thrives well in sandy peaty soil with a moderate supply of water. *Raspalia* is remarkable as being an instance in which the stamens arise from the top of a superior germen.

BRUNSFELSIA (Linnæus). A genus containing four species of hot-house evergreen shrubs, named after Otho Brunsfels, a Carthusian monk. The flowers are didynamous, and the plants belong to the natural order *Solaneæ*. They have showy white or purple flowers, and are easily cultivated.

BRUNSVIGIA (Heister). A beautiful family of bulbous plants, introduced from the Cape of Good Hope, and named in honour of the royal family of Brunswick. Like other liliaceous plants, they are hexandrious, and belong to the order *Amaryllideæ*. They are a magnificent genus, with ample foliage and flowers. Their bulbs grow to a large size, and consequently require large pots. When in a growing state they should be well supplied with water; but when dormant, like all the Cape *Amaryllideæ*, they must be kept perfectly dry.

BRUSSELS SPROUTS. A useful sub-variety of the Savoy cabbage, called *Brassica oleraceæ gemmifera*. The principal head is inconsiderable, and inferior. The plant rises to the height of three feet or more. The leaves are quickly deciduous; but from the axils of each, little compact heads are produced from the top to the bottom of the stem. These little heads continue long in season, and are always admired at table for their tenderness and flavour. Although Brussels sprouts may be had all the summer by timely sowing and culture, yet as they are not equal to other delicacies of summer, and as they are esteemed a winter vegetable, one sowing about the middle of April on a bed of dry rich soil, sowed with an ounce of seed, will furnish plants enough for winter and spring consumption for any moderate family establishment. Brussels sprouts should be planted in rows, two feet asunder every way, on rich well digged ground, and afterwards kept free from weeds and fallen leaves. To have true seed, it is recommended to save it from the side branches, it being found that seeds from the crown do not give the true character for which this vegetable is so much esteemed.

BRYA (Patrick Brown). Bryo, to sprout; seeds germinate before falling. This is a genus of two species; one, a native of Jamaica, and there, from the colour and hardness of its wood, is called ebony; the other has been, according to Loddiges' catalogue, received from Sierra Leone. They have Monadelphous flowers, and belong to the natural order *Leguminosæ*.

BRYAXIS (Knoch). A genus of coleopterous insects, belonging to the minute but very singular family *Pselaphidæ*. The tarsi are furnished with a single claw; the maxillary palpi are rather short, and the body is broad or ovate, with the extremity of the antennæ thickened. These insects are of small size, and are usually found in damp places amongst moss, during the winter and spring. We have met with several species in Battersea fields. Nine species are recorded as British in the works of Messrs. Curtis and Stephens, but of these the *Pselaphus insignis* of Reichenbach is an *Euplectus*, according to M. Aubé, whose memoir we have already alluded to in the article BRACHELYTRA; and the *Pselaphus nigriventris* of Denny belongs to the genus *Batrisus* of Aubé. We take this opportunity of introducing the article upon an allied genus, which was accidentally omitted in its place.

ARCOPAGUS (Leach). A genus of coleopterous insects, belonging to the family *Pselaphidæ*. The body is short and convex; the maxillary palpi terminated by a large hatchet-shape point, and the antennæ eleven-jointed, with the basal joint larger than the second. They reside in moss, &c., growing in damp situations and in marshes, throughout the year. There are four British species. There are some sexual peculiarities in this genus deserving of notice: the tibiæ of the fore legs in the males is notched, which character Mr. Curtis considers as characteristic of the genus; but Mr. Denny, in his beautiful work on this family, has also noticed it in another genus, *Bryaxis*. Moreover, as he observes, that the notch varies in size in the same species (*B. longicornis*), we may perhaps conclude that this is a specific instead of a sexual character, and consequently that two species of the present genus have been regarded as the opposite sexes of the same species.

In one sex (respecting which a difference also exists) the first joint of the antennæ is produced into a fine point on the inside.

BRYONY is the *Bryonia dioica* of Linnæus, a genus of herbaceous climbing plants, consisting of twenty-three species found in every quarter of the world. They bear unisexual flowers, and belong to the order *Cucurbitaceæ*. The red-berried bryony is frequent in hedges every where in England, and is easily known by its long rambling shoots climbing among the thorns of the hedge, dearing bunches of red nauseous berries in the autumn, and particularly by its immense tuberous root, sometimes weighing several stones. "These roots have been formerly, by impostors, brought into the human shape, carried about the country, and exhibited as *mandrakes* to the common people. The method which these impostors practised, was to open the earth round a young thriving bryony plant, being careful not to disturb the lower fibres of the root; to fix a mould, such as is used by those who make plaster figures, close to the root, fastening it with wire to keep it in its place, and then to fill in the earth about the root, leaving it to grow to the shape of the mould, which is effected in one summer."—*Lind.* The root has been long used medicinally, it being highly purgative and acrid.

BRYOPHILA (Ochsenheimer). A genus of lepidopterous insects, belonging to the section *Nocturna*, and family *Noctuidæ*. The body is very slender, thus differing from the majority of the family (which are termed simple-horned full bodies); the wings are slightly deflexed during repose. These insects, of which there are two British species, are amongst the smallest and most elegant species of the family; they are found upon old walls, &c., the larvæ feeding upon the lichens which grow there; the moths are about an inch in expanse, of a white or greenish hue, prettily variegated with black markings. The type of the genus is the marbled beauty, *Noctua perla*, of Haworth, common in the neighbourhood of London.

BRYOPHYLLUM (Salisbury). Bryo, to grow, and phyllon a leaf; young plants produced from the crenatures of the leaves. This curious plant belongs to *Octandria Tetragynia* of Linnæus, and to the natural order *Crassulaceæ*. The generic character consists in the flower having four sepals, four petals united into a cylinder, and many-seeded. This plant differs from the generality of others, by bearing young progeny on the edges of its leaves. In ordinary cases the young of plants are produced from seeds, or from buds attached to, and springing from, the stem or roots. These vital gems are either visible or hidden, and come forth under favouring circumstances of time, place, and temperature. Such plants are clothed with leaves also; but they are simple appendages, and possess in themselves no reproductive principle, nor are they constituted like the stems and roots in having a vital membrane. But the leaves of the plant we are noticing are actually foliaceous parts of the stem, and possess similar powers of reproduction; inasmuch that buds are not only present in the notches of the leaves, but are actually developed there, and fall to the ground perfect plants.

Viviparous progeny are produced by many different descriptions of plants, and in various ways. Bulbs put forth offsets, as the tulip; tubers increase their numbers by a similar process, as the potatoe; the strawberry, and many kinds of grass, send out runners, spreading far and wide. Of these powers of plants, it is evident that that of the bryophyllum is only a modification; but certainly very curious; being so unlike the ordinary modes of the reproductive processes of the vegetable kingdom. To propagate this plant, and there are a few others propagated in the same way, it is only necessary to take a leaf and lay it on the damp surface of a pot of earth; roots are quickly exserted, and several young plants obtained. It is a stove plant, requiring a dry porous soil, and very little water.

BUBO, Cuvier's generic name for the great horned, eared, or tufted owl. See the article Owl.

BUBON (Wildenow). The meaning of the name is uncertain, being employed by Pliny. A family of plants chiefly herbaceous, natives of Europe, Asia, and Southern Africa. They are pentandrious, and belong to the order *Umbelliferæ*. From the *B. galbanum*, the drug of that name is obtained. It is collected from the spontaneous exudation of the stem, or from an incision made in the stalk a little above the root, from which it immediately flows, and soon becomes sufficiently concreted for gathering. Medicinally considered, this gum-resin is said to hold a middle place between asafœtida and ammoniacum; but is less fetid than the former. The *B. Macedonicum*, cut and dried, is put among clothes to give a pleasant scent. They are plants of no beauty.

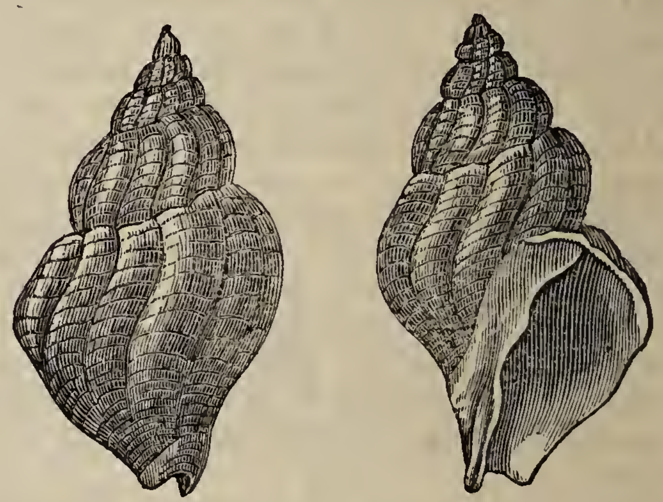
BUCCINUM (Linnæus, Lamarck). The extremely confused and widely extended genus *Buccinum*, as constituted by Linnæus, like many others of that great naturalist, required reformation; and Bragniere appears to have been the first to separate from it his genera *Cassis* and *Terebra*. There yet remained a great number of distinct species intermingled, rendering the generic characters of the buccinum still very vague and inconsistent. Lamarck, therefore, farther classified the enormous number of molluscs called buccina, and established the additional genera of *Harpa*, *Dolium*, *Monoceros*, *Concholepas*, and *Eburna*, each presenting distinctive and peculiar anatomical structures, very different from the Linnæan genus *Buccinum*. As it now stands, there are still a great variety and diversity of species, allied to each other nevertheless by characteristic assimilation.

The animal is well known, and will be described under *Entomostomata*, the second family of the order *Siphonobranchiata*. First class *Cephalophora*, of De Blainville's system of malacology, in which they are now subdivided as follows:—First, those that are smooth, the spire rather elevated, with the aperture enlarged in front, as in the *Buccinum achatinum*. Secondly, such as are more or less tuberculated, with the edges of the aperture separated by a notch or sinus backward, rather deep, the right side dentated in front, as in the *B. papillosum*. Thirdly, the oval species, which are rather globular and subcoronated on the whorls of the spire, as in the *B. glaciale*, and *B. undatum*. Fourthly, those species that are short, rotund and subglobular, as the *B. reticulatum*. Fifthly, such as are nearly similar in form, with a large callosity on the internal edge, as the *B. arcularia*, constituting Lamarck's genus *Nassa*, in which the thickened lip, and great callosity of the columella, with

Buccinum tuberculatum.

the irregular lump or tuberculations on the back of some species, are remarkably characteristic. Lastly, all the anomalous species, such as the *B. neriteum*, &c.; they all possess an operculum, which is oval, horny, and formed of subconcentric circles, its summit marginal and slightly marked.

The general characters of this mollusc are its being slightly covered with an epidermis, oval shaped, lengthened, and the spire moderately elevated; an oblong-oval aperture, notched, and sometimes anteriorly subcanaliculated, the right lip thickened, not turned over, the columella plain, and nearly all seen. They are found in every part of the globe, and many of them constitute a nutritious food, particularly in the northern countries. These molluscs are not very remarkable for the brilliant lustre of their colours, being for the most part of sombre tints, and inhabitants of cold climates; but their great diversity of form, delicacy of sculpture, and pencilled markings, render them highly interesting to the mere collector of natural history, without a reference to their more scientific examination. They nevertheless possess many useful purposes, which the rapidly increasing study of natural history may reasonably be expected to develope, some of which will be enumerated under the leading article Conchology. De France mentions thirty-six fossil species, but there is not so great a number as the genus is now constituted, and it is yet capable of



Buccinum undatum.

further alteration to great advantage. The name is derived from a trumpet (*buccinum*), and in the South Seas a large species—*B. giganteum*, of Linnæus; *Triton variegatum*, Lamarck—is used for that instrument.

BUCCO (Barbet, or bearded bird). A very numerous, but not very interesting genus of *Zygodactylic*, or yoke-toed climbing birds, combining some of the characters and appearances of the magpies and jays, with some of those of the more showy and elegant climbers. They are heavy birds for their size, and not swift either on the wing or in climbing. They are found only in the woods, and there upon the lower branches of the trees, and they move with some difficulty. Their bills, heads, and necks, are disproportionably large for the rest of their bodies. The base of the bill is surrounded by hairs or bristle-shaped feathers, from which they get their common English name of "barbet," and the generic name of *bucco* (puffy-cheek) is given them on account of an enlargement or tumefaction at the base of the bill, which consists partly in the cheek itself, and partly in the retroflexure of the hairs at the bottom of the gape. The beards or bristles form five tufts, one directed over each nostril, one at each side of the base of the lower jaw, and one under the chin. The

The bill is large, strong, conical, and sharp at the tip, which is a little bent. Like many others of the climbers, and indeed all birds which have the bases of their bills beset with bristles, they are omnivorous, eating insects, eggs, small birds, and fruits, and other succulent vegetable substances. They build their nests in the holes of trees, generally at but a small height above the surface of the ground.

They are usually divided into three sub-genera:—

1. *Barbicans* of Buffon. This sub-genus is found in the warmer parts of the eastern continent only, but in both parts of it, that is, in India and in Africa. They have the culmen of the upper mandible arched, but without any ridge, and blunt; and they have two strong teeth on each side of the same, on the cutting edges. They are said to feed more upon vegetable substances than the other two sub-genera. There are many species, some of which are found in Africa, some in the south-eastern parts of continental Asia, and some in the eastern islands, but they are all retiring, and what may be called dull birds of the deep forests, and thus their manners are very imperfectly known.

2. *Barbets,* properly so called (*Bucco*). These have the bill simply conical, without any ridge on the culmen, though that is a little raised in the middle. They are found in the two continents, but the greater number of the species belong to the eastern one. They are more gay in their plumage, and a little more lively in their manners, than the former sub-genus. The birds belonging to that are seldom seen in pairs, even in the breeding season; but those of this sub-genus are always found in pairs at that time, and generally in parties of about half a dozen or so at other times of the year.

3. *Tamatias* (*Tamatia*). This is said to be the native Brazilian name of a bird, but whether of all, or of any of those of this sub-genus, is not very well known. These have the bill a little larger and more compressed than the former sub-genera, and the upper mandible more hooked downward at the point. Their tails are also very short, and their heads disproportionately large and thick. This form gives them a very dull appearance, which is in no degree relieved by their manners, which are solitary, and to appearance melancholy. They are found only in South America, and there only in the depth of the forests, to the gloom of which they rather add, by the heaviness of their air, and the sluggishness of their motions. They are understood to be wholly or chiefly insectivorous. Their chief colours are black, white, and reddish brown, very delicately mottled in some of the species, but never gay. They are, in fact, among the least interesting of the birds of those head-quarters of the climbing birds of which they are natives, and there is nothing in their manners to redeem the homeliness of their appearance.

BUCEPHALUS. A species of Distoma approaching to the Infusoria, and even in some respects to the lower forms of vegetable organisation; it is a parasite of the fresh water muscle recently discovered, and deriving its name from the disproportionate size of the head.

BUCEROS (horn-bill), a very singular genus of birds, combining the characters of several other families, but having abundant peculiarities of their own, by which they are distinguished from all the other genera of birds. Their air and their habits have no inconsiderable resemblance to those of the crow tribe. They are quite miscellaneous in their feeding; fruits, small mammalia, reptiles, insects, carrion—all come alike to them; and they eat voraciously, casting up their food into the air, in order to swallow it, as their tongue is too short for being used in the ordinary way in assisting deglutition. The feet of these curious birds bear no inconsiderable resemblance to those of the king-fishers and bee-eaters—that is, they are in so far syndactylic, or have the three front toes, which are all of nearly the same length, united together at their bases, so as to form a kind of solid palm or flat to the foot. This is not a walking foot, neither is it one adapted for perching—that is, for holding on upon a branch or twig while the bird performs any action with the other parts of its body, but simply a foot by means of which the bird can stand firmly either on the ground or on a branch. To assist the birds in maintaining their standing posture firmly, the toes, both the three front ones and the hind one, are very much elongated, so that, instead of the toes all grasping toward a point, as they do in the anisodactylic feet, or toward a line passing across the middle of the foot, as in the zygodactylic, the two extremities grasp toward the palm or flat portion of the foot; and it will be easily seen that, for mere rest, or firmness of position, this description of foot is much better adapted than any other. But birds with such feet cannot walk, but are obliged to hop, and assist their balance in hopping by raising the wings. The hopping motion is, however, the one best suited for capturing the prey upon which these birds chiefly subsist.

The most remarkable character of these birds, however, is the bill, which is wholly unlike that of any other species. It is not only of very large size and peculiar shape in itself, that is, in the mandibles, which perform nearly the same function as those of other birds, but in certain additional parts to which there is not any thing corresponding in any other species. There are other birds which have enlargements at the base of the bill, as in some of the varieties of pigeons; and there are others, as, for instance, the coots, that have the horn of the upper mandible extended in a plate upon the point. But the horn-bills have a singular enlargement, which, in some of the species, is almost as large as the bill itself, of which it is not easy even to guess at an use. This part of the bill is cellular, and very light in its substance; and the whole of the bill, large and formidable as it appears, is weak and brittle. The tomia are naturally jagged, and they are often chipped into notches in the using.

All the species have not this singular protuberance, and none of them have much or any of it when they first come out of the shell; but it enlarges with age, and also changes its form, so that some of the birds might, at different ages, be taken for different species. In using this bill they do not peck, or strike, but seize their food, keep grinding it for some time between the jagged tomia, and then swallow it entire. They are all natives of the warmer parts of the eastern continent—that is, of Africa, of the south-east of Asia, and of the eastern islands, and perhaps they are most numerous in the last of these localities. There are many species, and they are usually divided into two sections—those which have a protuberance on the bill, and those which have not. We can find room for only one or two of the species in each division.

I. WITH A PROTUBERANCE.

RHINOCEROS HORNBILL (*Buceras rhinoceros*). This is a native chiefly of the eastern Archipelago, and it is the largest bird of the genus. Its length is nearly four feet, of which the bill takes up at least one foot, and the extent of the wings is about three feet. The true bill is slightly crooked, and the mandibles are rough and jagged in the edges. The protuberance is, in old birds, of nearly the same size as the bill itself. It advances for some distance upon the culmen of the upper mandible, with which it is connected as one substance, and then it turns upward something in the same manner, but not in the same form, as the horn of a rhinoceros, and terminates in a variously shaped point in different individuals. The true bill is black at the base of the upper mandible, passing through a dull reddish colour to pale straw yellow at the point. The protuberance is yellowish on the under side, and reddish on the upper; and there is a black line proceeding along the junction with the upper mandible on each side, and continued to the point of the protuberance, separating the yellow from the red. This line very much resembles the meeting of a pair of mandibles, and makes the bird appear as if it had two bills, the under one slightly curved, and tapering to a sharp point, and the upper turning upwards, and even backwards. The upper one, however, has no opening of any kind, but consists of a very thin horny case, covering and being connected with a number of horny cells, the walls of which are very thin, so that the whole protuberance is not heavier than a crest of loose feathers of the same size. The colours of this curious bill are much brighter when the bird is alive, and in good health, than in the preserved specimens.

The colour of the bird is black, but the tail, which is slightly wedge-shaped at the end, indicating a bird which has to make its way among bushes, or other tall vegetation, is tipped with dull white. The eyes are large, and shaded from the upward light by superciliary bristly feathers. The feet and tarsi are strong, and covered with large scales of a brownish colour, and the nails on the toes are flat and blunt. There is nothing about this large, and, at first appearance, formidable bird, that can in any way be considered as a weapon capable of doing injury to any but very small animals; and in countries where the waste of life is great as well as the production, it is understood that the chief office of the hornbill is that of scavenger. Its general manners are dull and sluggish.

THE UNICORN HORNBILL (*B. monoceros*) has the protuberance of the bill continued nearly parallel to the curve of the mandibles, and a portion toward the point, which is sharp, detached from the upper mandible. The general colour, as in the last-mentioned species, is black, but glossed with reflections of green and purple. The first three quills of the wings and the tail-feathers are white.

THE GREAT-BILLED HORNBILL (*B. cassidix*) is nearly of the same size as the rhinoceros, but it is more showy in its plumage. The body, wings, and thighs, are of a rich deep bronze, or rather nearly black green, of very splendent lustre, and brilliant reflections; the tail is white, the neck and breast rich golden yellow; and the top of the head, on which the feathers are produced and silky, forming a loose crest, is rich maroon red. The bill is about ten inches in length, very large at the base, but tapering toward the tip, and for the greater part of its length of an uniform yellow colour, but toward the base, each of the mandibles is sheathed with three ridges of transparent horny matter, which advance by curves upon the culmen and mesial line of the lower mandible. These ridges are of a reddish orange colour, and separated from each other and divide the yellow part of the bill by lines and furrows of deep black. The protuberance of the bill rises from the culmen, in front of the basal ridges, forming there a trenchant edge, standing naturally and rounded. It rises to nearly the same measure as the depth of the bill, and proceeds backwards in a curve descending on the head opposite to the posterior part of the eyes. The sides are formed into ridges convex to the front, and the whole is of a purple red colour.

This species is an inhabitant of the Eastern Archipelago, and it is said to be much more of a mountaineer than those formerly mentioned; but to be an inhabitant of the wooded mountains only, and to live chiefly upon fruits, which are very abundant in that part of the world. From the structure of this species, and the character of the vegetation where it is native, we might perhaps be led to conjecture, if not to conclude, that the protuberance on the bills of these birds, serves to divide the flexible vegetation for them so that they may see and reach those substances on which they feed.

Ten or twelve more species of hornbills with more or less of a protuberance on the upper mandible, are mentioned by systematic writers on ornithology; but too little is known respecting them for making the details of any use, or any interest to the general reader, as the greater part of them are only descriptions of single specimens which have not been seen by the describers till they were dead, and in part, at least, altered.

II. HORNBILLS WITHOUT PROTUBERANCE.

In all respects, except that of not having the enlargement from the base of the upper mandible, these appear to agree very much with the former division. The bill is of the same enlarged form, and nearly of the same shape; and there is not enough known respecting either the one or the other, for enabling us to know with any certainty, to what it is that the very singular formation of their mandibles adapts them. But as those with the protuberance are most plentiful in the Eastern islands, and those without in India and Africa, and as the former is the place where the most exuberant vegetation is met with, some colour at least is given to the conjecture which we have ventured to hazard; but we do not give that conjecture as an established truth; and, indeed, before we can consider anything as established respecting the habits of those most singular of all the feathered tribes (at least in the form of their bills), there must be much and careful observation in those places which they inhabit.

BUCHANANIA (Roxburgh). Named in compliment to Francis Buchanan, M.D. A genus of two East Indian trees, regarded for their fruit, being allied in some way or other to the mango. The trees were called *Mangifera* by Lamarck, and *Spondias* in the *Hortus Bengalensis*.

BUCIDA (Linnæus). So named from *bos*, an ox; the fruit being in shape like an ox's horn. It is a tree common in Jamaica, belongs to *Decandria Digynia*, and to the natural order *Combretaceæ*. The tree affects low swampy lands near the sea coast; it is remarkable for its slender crooked branches, and the tufted disposition of the leaves; growing to a considerable size, it is reckoned an excellent timber tree, and the bark is used by tanners.

BUCKBEAN is the *Menyanthes* of Linnæus. It receives its generic name from *men*, a month, and *anthos*, flower, because it remains that time in blossom. The flower is pentandrious, and belongs to the natural order *Gentianeæ*. There are two species, both aquatic plants: *M. trifoliata* is a common British plant, and one of the most beautiful of the British Flora. It is said that it is used in Sweden as a substitute for hops, two ounces of the leaves being considered equal to a pound of hops. It is also used medicinally, and recommended in cases of dropsy and rheumatism.

BUCKLER MUSTARD is the *Biscutella* of botanists, so called from *bis scutella*, a double shield, the form of its seed-vessel when bursting. There are several species, all inferior plants.

BUCKTHORN is the *Rhamnus* of Linnæus, a genus comprising thirty species of ornamental shrubs, chiefly evergreen, They are Pentandrious, and give name to a natural order, namely, *Rhamneæ*. The *R. alaternus* has already been noticed as a common and favourite shrubbery plant, of which there are nine varieties. Many of the others are found wild on the continent, and two are indigenous to England, viz. *R. catharticus*, and *R. frangula*. The berries of the first are sold as French berries, used to stain paper and maps; the juice mixed with alum makes sap-green; but if the berries be gathered late in the autumn the juice is purple; the bark dyes a fine yellow. The *R. lycioides* furnishes the wood of which the Moguls make their images, on account of its hardness and orange-red colour. *R. saxatilis* resembles *catharticus*. The berries are used to dye the morocco leather yellow. The leaves of the *Rhamnus Teezans* are used as tea by the poor in China. *R frangula*, found in British woods, have dark purple berries, which are purgative. Gathered before they are ripe, they dye wool green and yellow; when ripe, blue-grey, blue, and green. The bark dyes yellow, and with preparations of iron, black. The berries of this sort, and also those of the *cornus*, are sometimes sold for those of the buckthorn; but they are easily distinguished, the true buckthorn having four seeds, the *frangula* two, and the *cornus* one.

BUCK WHEAT is the *Polygonum fagopyrum* of Linnæus. The generic name signifies many-jointed, being the true character of the stems. The specific name should be Beech-wheat, because the seeds resemble beech-mast in shape. This plant is supposed to be a native of the warmer parts of Asia, though it is found apparently wild in many parts of Europe. It is impatient of frost, and therefore can only succeed in those months when no frost occurs. Its growth is rapid, and it is very prolific, sometimes yielding five or six quarters per acre. As an agricultural plant, it is of considerable value as food for all sorts of poultry, wild and tame. For cattle of every kind it should be given with other food in moderation, because it is of so hot a quality, that it will poison sooner than fatten even a hog. Swine fed with buck-wheat alone become restless, and almost raving mad; and if near water, are in great danger of drowning themselves, so much are they tormented with the inflammatory effects of the grain. To the distiller it yields a stronger spirit, bulk for bulk, than any other kind of corn. Much of the demoralising spirit gin is compounded of this grain; a worse ingredient could not be thought of. How the peasantry on the continent manage to use it in bread is unaccountable, unless it be that the spirit is dissipated by the oven. The health of horses are very often hurt by being allowed too much buck-wheat. One bushel mixed with five of oats is quite enough; and one bushel ground with two of barley is as much as even pigs should be fatted with.

It is only the farmer who employs light sandy or gravelly land that can grow buck-wheat, who, by sowing it, gains an advantage quite independent of its value. In fallowing such land for the purpose of sowing common wheat, it often happens that he gets his field perfectly clean before the beginning of June. If, at that time, he sows the land with buck-wheat, it will rise quickly, and shade the ground all the summer; and when dissevered, about the beginning of October, the ground will be left in better heart for the ensuing crop of common wheat, than if no intermediate crop had been taken. This is a consequence of shading the land during the summer drought, keeping down weeds, and having a rich succulent stubble to plough on. This plant is also sowed about the beginning of August, for the purpose of being wholly ploughed in as a dress; but for a crop of the grain it should be sowed any time between the twentieth of May and fifth of June. One bushel sows an acre.

BUDDLEA (Linnæus). Named in honour of a Mr. Buddle, an amateur of botany. There are ten species of this family, all more or less ornamental, and all tender, except one, the *B. globosa*, which stands our winters pretty well, if it receives the least shelter. The flowers are small and yellow, but, being united in globular heads above an inch in diameter, pretty fully distributed over the branches, make a showy appearance. The *B. neemda* is said to be one of the handsomest plants in Nepal, of which it is a native. The buddleas belong to the order *Scrophulareæ*.

BUFFONIA (Willdenow). Named after the celebrated French naturalist, Count Buffon. It belongs to *Tetrandria Digynia*, and to the natural order *Caryophylleæ*. Its generic character is: calyx of four sepals, having membranous edges; petals four, shorter than the calyx; stamens shorter than the corolla; capsule oval, one-celled, two-valved; seeds two, compressed. There are only two species; one is, though rarely, found in England; the other in France. The specific name of the English one, *Tenuifolia*, slender-leaved, was given by Linnæus, as expressive both of the leaf and of the *slender* pretensions to botanical distinction of the Count after whom it was named. It is said by another author, that Linnæus, to show his disrespect for the Count, slily dropped an *f* in the name!

BUG. The name of a disgusting insect belonging to the Linnæan order *Hemiptera*, section *Heteroptera*, Latreille, and distinguished systematically by the name of *Cimex lectularius*. It may seem almost superfluous to give a description of this insect, the very name of which produces a nauseous sensation, yet its peculiar characters as well as several points in its economy are not destitute of interest, and we trust that we shall not be charged with want of delicacy in dwelling upon them. In the first place therefore it is to be noticed as a curious circumstance, that, although belonging to an order of winged insects, the *Cimex lectularius* is destitute of organs of flight, a deprivation which appears attributable to the peculiar habits of the insect, which would in a great measure render the possession of wings almost useless; there is, however, to be perceived a pair of flat, rounded, and moveable appendages, occupying about one-sixth part of the abdomen, and which are evidently the rudiments of a pair of wing-covers. The abdomen itself is flat and nearly of a rounded form. The rostrum or sucker is attached to the under side of the head, and when unemployed is extended towards the breast; but this organ, instead of being four-jointed, as in the majority of the great Linnæan group *Cimex*, is composed of only three short joints, enclosing several fine setæ or bristles, which serve not only to wound but also to act, by way of capillary attraction, in raising the blood of the objects attacked. This numerical deficiency induced Latreille in his 'Familles Naturelles' to unite this insect with several other groups into a separate tribe which he termed *Membranaceæ*, but the *Cimex lectularus* is distinguished from all the insects with which it was thus associated, by the slender thread-like terminal joints of the antennæ, a character of some importance in the classification of the Linnæan *Cimices*. Fabricius states that the mouth is unfurnished with any lip, but we have distinctly perceived this organ at the external base of the rostrum, in the form of a small and flattened nearly oval plate. The tarsi of the cimex are three-jointed, in which respect it likewise differs from the other membranaceæ. In respect, therefore, to the structure of this insect, we find numerous characters which throw considerable difficulties in the way of its classification amongst the other species of the Linnæan geuns. Fabricius has introduced much confusion into the nomenclature of these insects, by applying the term *Cimex* to other species, and by placing the *Lectularius* in his genus *Acanthia;* this improper application of names, although not adopted in France and England, is still pursued in Germany, where the Fabrician system was most deeply rooted. The original English name, as we learn from Mouffet, was likewise different from that now universally given to this insect, which in his time (1634) was termed wall-louse, and Messrs. Kirby and Spence suggest that the term bug, which is a Celtic word signifying a ghost or goblin, was applied to them after Ray's time, most probably because they were considered as "terrors by night;" hence, our English word bug-bear: and in like manner the passage in the Psalms, "Thou shalt not be afraid for *the terror* by night," (xci. 5,) is rendered in Matthew's Bible "Thou shalt not nede be afraid of any *bugs* by night."

Southall in his treatise upon the Cimex Lectularius, published at Ipswich in 1793, and which reached a second edition, states that the first appearance of bugs in London, occurred after the great fire in 1666, "which learned men," says he, "united in thinking were imported with the new deal timber, as the bugs were naturally fond of turpentine woods." That the latter circumstance took place is perhaps perfectly correct*; indeed, Linnæus was of opinion, that this insect is not originally a native of Europe, and that it was imported from America; but there is abundance of evidence to show that they were known in England before the great fire, since Mouffet records the circumstance which occurred in 1503, of a Dr. Pennius being called in great haste to visit two noble ladies, residing at a little village called Mortlake, on the banks of the Thames, who were greatly alarmed by the appearance of bug bites, which were considered as symptoms of the plague or some such contagious disease, and whose fears were only dispelled by the capture of the insects and the statement of their physician, who happened also to be a naturalist. As a native of Europe it has been known for centuries, being noticed by Aristotle (Hist. liv. 5. chap. xxxi.) under the name of Coris, by Galen, Dioscorides, Pliny, &c., who state the medical virtues which it was supposed to possess, especially as a remedy against the bite of serpents. It was also applied in numerous other diseases, as we learn from Mouffet, who has collected the learning of the ancients and of the middle ages upon this and other similar subjects. The medical student of the present day will smile at learning that twelve live bugs taken fasting (four per diem) was an approved remedy against the colic. Whether the apparent rarity of these insects in England was the result of the superior cleanliness of its inhabitants over those of France, Germany and Italy, as Mouffet states, may, perhaps, indeed be doubted; certain it is that it now thrives in our climate as well as elsewhere, sometimes, especially when unmolested, swarming to a most intolerable degree, not only in inhabited but also in empty houses, getting under the wainscotting, &c., where it appears strange that it should be able to obtain nourishment. A precisely analogous case, however, occurs in the musquito and some other bloodthirsty insects, which, although they are exceedingly tormenting, must, from their place of residence being in damp, marshy, and unfrequented situations, for the most part be totally unacquainted with what appears their natural food. So, in like manner, we are informed by Oedmann, in the New Transactions of the Academy of Sciences of Stockholm, that it is a prejudice amongst the country people in Sweden, that the house bug resides in the common yellow wall lichen which grows on juniper bushes, &c., but that no entomologist ever yet found the real house bug in standing trees; and he proceeds to detail some circumstances which appear to prove that these insects are occasionally resident in trees, stating that some workmen in the month of August, whilst engaged in cutting wood in Namdo Sound, aroused a bat which flew out of a hole in a hollow elder tree: searching for more, the workmen hit the tree violently, and a mass was heard to drop, which on being pulled out consisted merely of bugs; it was impossible that they could be deceived with such well known vermin; moreover, they found beneath the wings of the bats real bugs in addition to the usual insects which infest those animals. The whole quantity of bugs amounted to about three quarts. M. Blix, examining this phenomenon, found in the bottom of the hollow tree two nests of bats, formed of straw and soft earth; and

* "A sort of prejudice exists in England, and particularly in London that while all old houses swarm with bugs, the newly built ones are exempt from this execrable annoyance; in no part of the metropolis, however, are those noxious insects to be met with in such abundance, as in the new houses erected in the Regent's Park, into which they have been introduced in the American timber employed in their construction. On examining the timber as it comes from the ship, it will be found that the bugs absolutely fill up the crevices."—*Monthly Mag.*

afterwards, on examining the roof of another hollow tree, from which he had driven thirty-seven bats with a stick, its extremity was covered with bugs. At Christmas neither bats nor bugs were to be found in this tree, which had been also inhabited by woodpeckers and squirrels, the bugs having probably been carried from some habitation by the bats, and having been found in company with them in the former instance on an uninhabited island. It may be asked, how so many bugs could have been nourished upon so few bats, even supposing that they were really parasitic upon them; but stone-buildings are occasionally infested with bugs although uninhabited for a year, and yet the numbers have not been lessened; hence Oedmann supposes that they eat one another when they have no other nourishment, their loss being supplied by their great multiplication. In confirmation of which, M. Carlson adds, that, in 1777, he found an old rotten stake, which had been used as a hedge-stake, and not in or near either house or building, so covered with bugs, that it resembled an ant-hill; it was not hollow, and therefore could not be inhabited by bats; he therefore concludes that they live and propagate even in timber; they also bear the winter cold, as he placed a piece of furniture in the open air for three winters, and every summer bugs were observed upon it in great numbers.

It would appear that there are several species of these insects. Fabricius, after describing the common European species as never occurring with wings, adds another species, under the name of *C. hemiptera*, having rudiments of wing-covers, and inhabiting the houses of South America.

Southall, who tells a marvellous story of his journeying to the West Indies, where he was tormented with bugs, and of his meeting with "an ancient black negro, very clean," who informed him that his cleanliness was owing to his being free from bugs, describes and figures the American bug, which is somewhat larger than our common species. Latreille also states that the latter has been asserted occasionally to acquire wings. It also infests young pigeons, swallows' nests, &c.; but those which live upon the latter bird appeared to him to form a distinct species. More recently, at the meeting of German naturalists at Breslaw, a winged species was described under the name of *Cimex domesticus*. According to Southall, these insects are eleven weeks in attaining their full growth, and they spawn four times in a year.

Numerous remedies have been from time to time proposed by various writers for the purpose either of driving away or killing these insects, which are almost as notorious for their disagreeable scent as for their annoying propensities. Of these remedies, Mouffet gives a long list; Mr. Brande has given another in the index to the Materia Medica. We have known that an uninhabited house which swarmed with these insects has been completely cleared by a powerful fumigation of brimstone. And Southall, who obtained from his "ancient black negro" the secret of making a fluid for the prevention of bug bites, states it to have been made by boiling several strong herbs, as herb Robert, cormint, &c. in water, and adding corrosive sublimate and sal ammonia; this liquid being applied with a sponge to furniture, &c. Our readers will, perhaps, smile at this statement, and inquire how the negro had gained a knowledge of English herbs, and the other substances employed, and will probably be inclined to think the whole story to savour rather of quackery. We will only add, that these remedies are, for the most part, either insufficient or dangerous, and that by carefully examining furniture infested at the commencement of the spring, and by strict cleanliness, they will either be entirely destroyed, or their numbers considerably reduced.

But if our common species, which does not exceed a sixth of an inch in length, be able to produce such annoyance, how much greater must be the torment caused to the inhabitants of Chili by a winged insect called benchuca, in shape and form like our common species, but of the size of a cockchafer. This species conceals itself by day in the thatch and cane roofing of the houses, and sallies forth at night in quest of food. They annoy people much after the manner of our bug, but from their great size are terrific enemies. They are thin and flat like the common bug, but after satiating themselves with blood, of which they take as much as the medicinal leech, they become quite round. St. Pierre likewise, in his Voyage to the Isle of France, mentions a species of bug found in that island, the bite of which is more venomous than the sting of a scorpion, and is succeeded by a swelling as large as a pigeon's egg, and which continues for four or five days.

In speaking of the paucity of the species belonging to the genus *Cimex*, the student will understand that we refer to the restricted group adopted by modern entomologists. The Linnæan genus comprises several hundred species, which together compose the section *Hemiptera geocorisa*, or the families of land bugs, the majority of which are furnished with ample-sized wings and wing-covers; the latter, however, instead of being of the same substance throughout, as is the case in the beetles and grasshoppers, are opaque and coriaceous, or leathery, at the base, and membranous at the extremity, the two parts being separated by a strong nerve. They also differ from the beetles in the nature of their transformations; for, whilst the latter pass the intermediate state between the grub and beetle—namely, that of the pupa—in a quiescent state, the bugs are active throughout the whole period of their existence. It is true, however, that they undergo a series of changes perfectly analogous to those of the beetles. Thus, during the early portion of their lives, they shed their skins several times, by which means they are enabled to increase in size; they then again shed their skin, when a pair of short rudimental wing-covers are seen upon the back, which, at the next moulting, are developed into a large pair of wing-covers, concealing a pair of delicate wings. The *Cimex lectularius* undergoes these changes as well as the winged species, but in it the development of the wing-cases is not perfected. This insect is devoured by another Linnæan species of *Cimex*, viz., *Reduvius personatus*, so named from the covering of dust, &c., beneath which the larvæ is masked.

BUGLE is the *Ajuga* (a yoke) of Linnæas. A family of herbaceous annuals and perennials, containing eleven species, four of which, and two varieties, are inhabitants of Britain. They belong to the natural order *Labiatæ*, and though all wild, are rather handsome flowering plants.

BUGLOSS is the *Anchusa* (paint for the skin) of Linnæus. A genus of annual, biennial, and perennial herbs, chiefly natives of Europe. They belong to *Pentandria Monogynia*, and to the natural order *Boragineæ*. The common bugloss, *A. officinalis*, or ox-tongue, and the evergreen, *A. sempervirens*, are natives of Britain; the former resembles, and possesses nearly the same qualities as Borage. Its root was formerly used for giving colour to the lips and cheeks of those who were told they were sick or too pale. The flowers secrete honey, which is eagerly gathered by bees. *A. tinctoria* is cultivated in the south of France for the roots, which give a fine deep red to oils, wax, and all unctuous substances, as well as spirits of wine. This is called Rhatany Root in commerce, and is much used by apothecaries for colouring plaisters, lip-salves, &c., and by vintners for staining the corks of their port-wine bottles, or for colouring the compound sometimes sold as port-wine.

BUGWORT is the *Cimifuga* (bug-driver) of botanists. A genus of four species (formerly called *Actæ*) of perennial herbs. The flowers are polyandrious, and the plants rank in the order *Ranunculaceæ*. Whether any of the species possess the virtue attributed by the name is uncertain; but the root of *C. serpentaria*, called Black-snake Root, is used, it is said successfully, by the native practitioners of physic in North America, for curing the bite of the rattlesnake.

BULBINE (Willdenow). A genus partly of bulbs, whence the name is derived. They have hexandrious flowers, and belong to the order *Asphodeleæ*. They are natives of the Cape and New Holland, and, like most of the bulbous plants from the same localities, are desirable ornaments for the green-house and conservatory, the flowers being both showy and fragrant. Their propagation is also easy, as they produce abundance of suckers. Linnæus, R. Brown, and Thunberg, ranked several of the bulbines with the anthericums.

BULBOCASTANUM is the specific name of the Earth-nut, given in English botany by Smith and Sowerby: noticed under its proper name.

BULBOCODIUM (a woolly bulb), so called by Linnæus. Of this genus there are two species; one Spanish, the other from the Crimea. They are hexandrious, and belong to the order *Melanthaceæ*. They flower only in the spring, and have much the appearance of a crocus.

BULIMULUS (Leach). A genus separated from Bulimus, which see.

BULIMUS (Lamarck; Helix, Linnæus), or more properly Bulinus, Mr. Broderip having pointed out the propriety of correcting the orthography, it being evidently a typographical error in Scopoli's work, which has been copied by subsequent writers. Of this beautiful genus of molluscs, all of which are terrestrial, some were blended by Linnæus in the genus *Bulla*, and others with the genus *Helix*, from which they essentially differ in several points, and particularly in never being of an orbicular shape. The animal, it is true, in every part of its organisation, resembles that of the common helix; but the structure of the shell being altogether different, it must necessarily be separated from either the genus *Helix* or *Bulla*. This mollusc is ovate, oblong, or spiral, more or less ventricose; sometimes subturriculated; the summit of the spire obtuse; the last whorl larger than all the others united; the aperture entire, longer than wide; margin very unequal; the columella straight, smooth, not truncated, or widened at the base; and when the shell has attained maturity, a reflected lip is formed, thickened round its circumference on the right side, and frequently nearly covering the umbilicus on the other. In the *B. ovata*, the type of this genus, the outer lip has a thickened callosity at the junction of the columella, not noticed by Lamarck. These molluscs have no operculum; their substance in some species is extremely fragile; and in a young state the margin of the aperture is smooth and sharp; all of them are oviparous; and the eggs of some species are nearly as large as sparrows' eggs. Many of the species are sinister, or with the whorls turning towards the left hand, of which such as have the aperture pointed at the two extremities have been formed by Gray into his genus *Balea;* and of the species which are slightly umbilicated, Leach has formed his genus *Bulimulus.* De Blainville does not, however, admit of sufficient reason to separate them, and consequently merely forms a subdivision of them; his arrangement now stands in a well defined and simple order as follows:—the first, oval and of the ordinary form, as in the *B. hæmastomus;* secondly, the ventricose or bellied species, *B. ventricosus;* thirdly, such as are turriculated, as in the *B. calcareus;* fourthly, *B. citrinus* (*Balea* of Gray), nearly all the species of which are heterostrophe or left-handed; and lastly, such as are slightly umbilicated, forming Leach's *Bulimulus*, the type of which is *B. trifasciatus*.

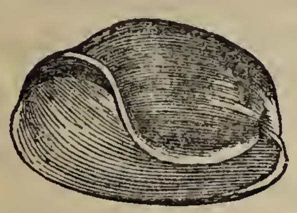
These molluscs constitute a genus very generally found in almost every part of the world, from the torrid zone to the frigid regions; in the former, as with every other species of molluscs, they are larger and more beautifully coloured, and among them will be found the lemon, amber, and sea-green colours, so rarely found as a pigment in other testaceous shells, if we except some species of the helix, their immediate congenors. They are more commonly found in islands, or on the margins of the sea, than in the interior of the land; and as far as their habits are known, the animal perfectly resembles the common snail.

Lamarck enumerated fifty-four recent species, but from the present arrangement the number is more limited; of the fossil species about forty have been described. De Blainville places this genus in his second class *Paracephalophora*, first order *Siphonobranchiata*, and the family *Limacinea*, or *Helix* of Linnæus.

The derivation, given by a modern writer, of bulimus from *voracious*, for the reason above given, now falls to the ground, and none has been offered for bulinus.

BULLA (Lamarck, Cuvier). This genus of molluscs, as constituted by Linnæus, included a great variety of the most opposite genera, which by Lamarck and other modern naturalists have been removed from it, and separately classed in natural groups, under the names of *Bullæa*, *Ovula*, *Achatina*, *Physa*, *Terebellum*, and some are comprised in the genera *Pyrula* and *Bulinus*. The great confusion that formerly existed in consequence of the manifest incongruity of blending together marine, freshwater, and land shells is now obviated, and a clearly defined and natural association of species formed, each possessing characters easily distinguishable, and Bulla may now be described with one consistent family character, perfectly unlike all other shells with which it was intermingled by Linnæus. This mollusc is an univalve, of an oval form, more or less globose, as it were rolled up loosely, having no columella, and being without a visible spire in most of the species; the large external whorl elevated above the others, giving an umbilicated appearance to the upper part of the shell; the aperture is open the whole length of the shell, and usually wider at the base; the outer edge sharp and smooth; it sometimes attains a considerable size, and is very prettily clouded with red or ash-coloured markings, broad pink, and black bands or fine lines. The type of the genus *B. lignosa* is of a straw colour, and elegantly marked with hair-like lines running spirally; and the animal possesses a very singularly formed testaceous substance within its body, not noticed by Lamarck, and familiarly called by English collectors the gizzard. The animal inhabiting the bulla has an oblong oval body, thick and obtuse at the extremities, which are formed of two parts, the posterior entirely covered by the shell. with the edges of the mantle thickened in front, but particularly so, backward on the left side, where it forms a lobe bordering the aperture; the anterior more considerable, provided on the right and left with a swimming enlargement of the foot; the head indistinct, with two inconsiderable labial appendages, two sessile eyes very distinct, and behind these a pair of tentacules prolonged on the lateral parts of the neck.

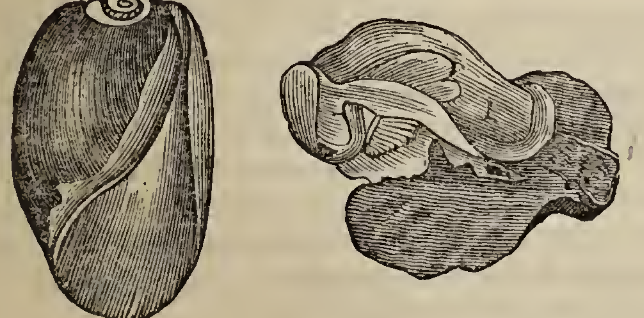
De Blainville places the bulla in his second class *Paracephalophora*, third order *Monopleurobranchiata*, fourth family *Acera*, and he arranges the species in the following order:—first, such species as are closely convoluted, with the spire visible and projecting externally, the aperture very narrow backward, as in the *B. jonkaria*, here figured, and forming the genus



B. jonkaria.

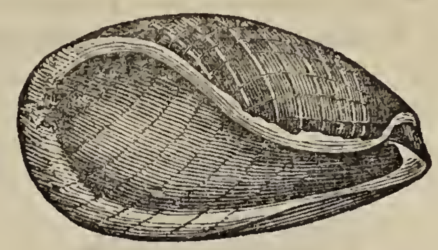
B. aplustre.

Aplustre of some autnors; secondly, the species that are completely convoluted, rotund, the spire very distinct, but not projecting, with a sort of thickened band at the anterior part of the columella edge, as in the *B. aplustre*, here figured; thirdly, such species as are of a thicker substance, very completely convolved, the turns of the spire scarcely visible in an umbilicus more or less deep, projecting inwardly, as *B. hydatis*, in the figure; fourthly, the species that are thin, ventricose, the turns of the spire externally visible, but not projecting, with a suture, as if channelled, and without any thickened band on the columella side, as in the *Bulla naucum*; fifthly, the species extremely thin, much involved, the turns of the spire distinct within and without, the suture deep, angular,



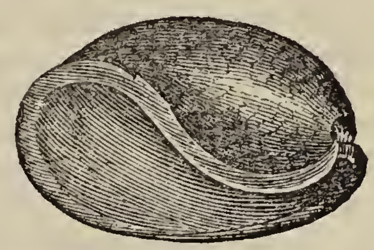
B. fragilis.

and channelled the whole or part of its length as in the *B. fragilis*, here figured; sixthly, the species in which are much more involved than the others, and without the spire being visible internally or externally, as in the *B. lignaria*, figured below; and lastly, the internal species, which are very thin, convoluted, with a



B. lignaria.

nal species, which are very thin, convoluted, with a slight commencement of becoming rolled at the origin of the left lip, as in the *B. aperta*, here figured, constiuting Lamarck's genus *Bullœa*.



B. aperta.

De Blainville has thus united Lamarck's genus bullœa to the bullæ, the propriety of which we do not admit, as the reasons which led to their separation remain unshaken. In the first place, the genus bulla is never an internal mollusc, and can altogether recede within its covering. The animal is also attached to its shell by a muscle, while, on the contrary, the bullœa is totally enveloped in the mantle of the animal, not visible externally, nor attached to the shell by any muscle; to which may be added, that the thickness, colouring matter, and more regular convolutions of the bulla, seem to mark it most distinctly as a separate genus. It is true they are both said to be carnivorous, and to swallow bivalve molluscs, but the evidence of that circumstance appears to want confirmation.

These shells are found in all climates, but the most beautifully coloured are from the warmer latitudes. Lamarck enumerates eleven recent species, and about ten fossil have been described by different authors.

The derivation of the name of this genus is obviously from a bubble, which their inflated appearance and slight texture greatly resembles.

BULLACE TREE is the *Prunus insititia* of Linnæus. This is a useful fruit-tree, and often found wild in the hedges about old farm houses. Why it should be called *insititia* (grafted) is not explained, as it propagates itself by suckers as easily as its congener, the sloe. Indeed, the bullace seems to be only an intermediate variety between the sloe and the damson plum, being much better and larger than the first, though not so large nor so good as the last. A bullace pie is a standing dish at the harvest-home supper in the south of England; only, it requires rather more sugar than the housewife is always willing to allow.

BULLFINCH. See PYRRHULA.

BULLŒA (Lamarck). This mollusc has been separated from the genus *Bulla*, for reasons which are stated in the description given under that name. The type of the genus and the only species known to us, as being exclusively *an internal shell*, without spire or columella, and involved or turned so loosely round from its origin, is the *B. aperta*, figured p. 643. De Blainville indeed has added to the genus thus characterised by Lamarck, two other species, the *B. ampulla* and de Ferussac's *Bullæa*,

B. ampulla.

distinguishing the inhabitant of these species either with an external or internal shell, by having the foot thicker, not dilated into swimming appendages, and possessing in fact distinct habits from the bullæ, which swim with great freedom, while the bulloea climb well and swim badly. We are not, therefore, disposed to adopt his classification in this instance, and consider the *B. aperta* as a well defined species, quite distinct from those added by de Blainville, though upon reasonable grounds. We shall endeavour to point out in the proper places of this work, that a peculiar character attaches to internal shells, which may be traced in a connected series, from such as are quite or nearly flat, as in the genus *Umbrella*, to such as are like the present genus and the bulla, and we think to prove satisfactorily that in most cases climate and the force of habit, or the necessities of nature, have led to the peculiar configuration of each, never presuming, however, to arrogate to ourselves the power of accounting for the wisdom of the Great Creator of all, beyond reasoning by the light of analogy and our own finite understandings.

BUMELIA (Swartz). A genus of West Indian shrubs and trees, consisting of fourteen species, belonging to the natural order *Sapoteæ*. Some of them are timber trees, and they mostly have fine foliage, but their flowers are inconspicuous.

BUNIUM (Linnæus) is the earth-nut of the provinces; a very common tuberous-rooted plant in some places, eagerly sought and eaten by hogs. The flowers are pentandrious, and are produced in umbels; of course the plant belongs to the order *Umbelliferæ*. The foliage is attenuated, much divided, and lies close to the ground. The tubers are about the size of hazel nuts, and may be eaten raw. They have a sweetish nutty flavour, and are said to be very nutritious. They are also used either boiled or roasted; and in Italy are called ground chestnuts.

BUNTING. See EMBERIZA.

BUPALUS (Leach). A genus of moths belonging to the great family *Geometridæ*, or Loopers. This genus was proposed by Dr. Leach in the Edinburgh Encyclopædia, and was characterised by the antennæ of the males being pectinated, the body slender, the palpi slightly hirsute, and the wings horizontally extended, and neither angulated nor indented. The type of the genus is the *Phalæna Geometra Piniaria* of Linnæus, or the bordered white of English collectors, a pretty species, about an inch and a half in expanse, with dark brown wings, having a large basal whitish spot, and another towards the anal angle of the upper wings of the same colour; the lower wings (except the outer portion) are whitish, with two irregular brown bands. This species frequents fir plantations, but it is by no means a common species, especially in the metropolitan district. We have taken it on Porstsdown Hill, near Portsmouth, the ridge of which is ornamented with rows of firs, which form so conspicuous an object from the opposite coast of the Isle of Wight. It is indeed fortunate that it is thus rare amongst us, since it will be seen, from the following account, that it is capable of committing considerable ravages. This communication is extracted from a report addressed by the inspector of forests at Strasbourg to the bureau of the administration of woods and forests at Paris, and is published in a recent number of Silbermann's Révue Entomologique. —"At the end of 1832, a malady occurred amongst the fir trees in the forest of Hagenau, one of very considerable extent, near Strasburg, extending over 7000 hectares. The firs, covering a space of about forty hectares, were observed to have their leaves of a yellow colour, and of a dried appearance. The cause of this malady was at first sought for in vain; but during the following year, it was so much increased, that more minute researches were made, and it was at length discovered that it was owing to the attacks of the larvæ of the bupalus, which commenced its ravages at the commencement of the month of May, passing from tree to tree until the month of October, when it descends to the ground to undergo its chrysalis state. The hundred hectares attacked in 1832 are now entirely destroyed without hope of future vegetation." In conclusion, the inspector calls upon entomologists to suggest plans for preventing the extension of so serious a damage.

BUPHAGA (*pique-bœufs* — cattle-pecker). A genus of birds, belonging to the *conirostral* division of Cuvier's great and miscellaneous order *papeus*. The name of this bird has been sometimes given in English as the *beef-eater*, but that is a mistake. It does not eat "beef" in our sense of the word, that is the flesh of dead cattle, and a bird not the size of a thrush can hardly be expected to eat live oxen in the field. The fact is, that it eats the eaters of the live flesh of the ox tribe and the other large ruminant mammalia. In the central parts of Africa, of which this bird (for there is only one species) is a native, these animals are terribly infested by insects which deposit their eggs in the skin, and leave them to be hatched by the heat of the animals; and these birds diligently resort to the animals which have their backs filled with the larvæ of these insects, dig them out and eat them. The only species is *B. Africana*, about the length of a song-thrush, but more slender in the body. It has the bill well formed for the particular office which it performs. The basal part is cylindrical, there it enlarges toward the tip, which terminates in a blunt point. Thus they are calculated to make an opening into the tumour occasioned by the larva, sufficient to draw it out, and also to lay hold of it and extract it with much more certainty than if they were of smaller dimensions and sharper at the points. The opening also prevents that inflammation and suppuration which are said to attend the presence of the larva in that warm climate.

BUPRESTIDÆ (Leach). A splendid family of coleopterous insects belonging to the section *Pentamera*, and sub-section *Serricornes*, or those which have the antennæ serrated, and not terminated by a club, and corresponding with the Linnæan genus *Buprestis*, of which upwards of a thousand species are known in collections.

The two Linnæan genera, *Buprestis* and *Elater*, are nearly related to each other, and compose a division termed *Sternoxi*, from having the prosternum terminated in an acute spine, and the body is of a firm consistence, with the head immersed to the eyes in the prothoracic cavity. In the latter of these two groups, this prosternal spine becomes of essential service to the insect, being employed, in conjunction with a corresponding cavity in the front of the mesosternum, to effect those singular leaps which have given to the Elateridæ the common name of Spring Jacks. The Buprestidæ, on the contrary, are destitute of this power, being unable to leap; since, although the prosternum is produced behind into a spine, there is no corresponding cavity for its reception as in the former. The latter family is further distinguished from the Elateridæ by having the jaws short, strong, and entire at the tip, and the terminal joint of the maxillary palpi either nearly cylindric or oval. The body of these insects is generally oblong, or oblong oval, and narrowed behind; and the penultimate joint of the tarsi is bilobed.

These insects are, for the most part, inhabitants of tropical climates, where the splendour of their metallic colouring corresponds with the richness of the flowers and the brilliancy of the butterflies. Very few species are found even in the central portion of Europe, and in England scarcely more than half a dozen can be considered as really indigenous. They are found upon trees, creeping but slowly, although they fly well in the hottest sunshine, taking flight with great facility; when in danger they have no other means of escaping from their adversaries, than to fold their antennæ and legs along the body, and drop from the branches upon which they ordinarily rest, into the grass. We believe no authentic account has hitherto been published of the economy of these insects in the larva state, considering that the statement of Madame Merian relative to the transformations of *B. grandis*, an inhabitant of Surinam, to be very unsatisfactory. It is probable, however, that they reside in timber in their early states, since the perfect insects are often found in timber yards and other places where quantities of wood have been placed. Another circumstance which corroborates the opinion that the larvæ feed in timber, is the great length of time which some of them are recorded to have passed previous to assuming the perfect state, and which is known to be the case with other xylophagous insects, as the *Prionidæ*, &c.; thus one of the most remarkable instances of insect longevity is recorded in the tenth volume of the Linnæan Transactions, in which it is stated by Mr. Marsham, that a Mr. Montague, on going to his desk in the Office of Works at Guildhall, London, observed an insect which had been seen by his brother in the early part of the day, endeavouring to extricate itself from the wood which formed part of the desk; he carefully released it from the cell, and it proved to be the beautiful *B. splendens* of Fabricius, full of strength and vigour. The desk had been fixed in the office twenty-two years before, and was made of fir wood imported from the Baltic. That the insect existed in the wood before the desk was made, was proved by the fact, that the channel formed by the insect had been then transversely cut.

These insects have been designated *Richards* by Geoffroy, a name originally given to the Jay, in consequence of the facility with which that bird was taught to pronounce the word; and the French Entomologist, from a fanciful analogy between this group of birds and insects, gave to the latter the same name as the former, because, says he, "les pays étrangers en fournissent de très-grandes et tres-brillantes espèces; c'est ce qui nous a porté à donner le nom de Richard à cet insecte." In fact, nothing can exceed the brilliancy of colour of some of the species, some of which have a general coppery tint, whilst others present the beautiful contrast of fine yellow or flame-coloured spots or lines, on a polished blue, green, or bronzed surface, and others exhibit the appearance of burnished gold, inlaid on emerald or ebony. In fine, all that is rich and brilliant in colours may be observed in the decoration of these insects. The females have a coriaceous appendage at the posterior part of the abdomen, composed of three pieces; this is probably the oviduct with which they deposit their eggs in crevices of old wood and trees. Their existence in their perfect state appears to be short, and is devoted almost exclusively to the great object of continuing the race.

The systematic name of these insects has likewise been involved in some confusion. By Linnæus, whose nomenclature has been adopted by all entomologists, they were inappropriately termed buprestis. This name, as well as the synonymous one of *Vulprestis*, was employed by the Roman naturalists, and that of *Voupristi* by the Greeks, to designate a noxious insect, which possessed such irritating powers when taken internally, that cattle, which accidentally swallowed them when feeding upon grass, died of inflammation in a short time, the insect acting as poison to them. Indeed so powerful were the effects of the application of this animal, that we find that legislative enactments were passed respecting it; the Cornelian law punishing with death those who should with malice prepense administer either it or the insect called *Pithyocampa*, having similar powers:—"Qui buprestem vel pityocampem, tanti facinoris conscii, aut mortiferi quid veneni ad necem accelerandam dederit, judicio capitali et pœna legis Corneliæ afficiator." According to Pliny, this insect was rare in Italy, and resembled a scarabæus with long legs. Now this insect, it would seem, was regarded by Linnæus as one of those to which he gave the name of buprestis; but these, as Messrs. Kirby and Spence observe, being timber insects, are not very likely to be swallowed by cattle with their food. Mouffet, on the other hand, followed by Geoffroy, regarded the ancient buprestis as a species of ground beetles, *Carabus*, giving to the Linnæan buprestis the name of *Cucujus;* the former insects, however, seldom or never frequent pastures. The larger species of carabi are rare in the south of Europe, and even did they exist there, they are found upon the ground under stones, and are sufficiently agile to escape from the murderous jaws of the cattle. Moreover, from several passages in the old writers, it is evident that these buprestis were vesicatory beetles; and M. Latreille, in an extended memoir which he has published on this subject, in the "Mémoires du Museum," has endeavoured to prove that they are referrible to the modern genus *Meloe*. The same author has more recently stated that Dr. Boisduval has employed the meloes as vesicants, and has ascertained that they possess greater energy than the common cantharides of the shops. Belon, nevertheless, in his

Voyage to Greece and the other Countries of the Levant, states that the insect named voupristi by the inhabitants of Mount Athos is able to fly, that it emits a strong and fetid odour, that it resembles a cantharis, but that it is larger, of a yellow or buff colour, and that it is often found upon chicoraceous plants. Now these characters indicate a species of mylabris rather than a meloe, whence Latreille is induced to regard the ancient buprestis and voupristi is two distinct species of insect. Messrs. Kirby and Spence, on the contrary, consider the insect of Mount Athos (which is so noxious that when horses or other cattle even feed upon the herbs which the insects have touched, they die from inflammation, and which is an immediate poison to oxen) to be the buprestis of the Greek writers, and as Pliny usually compiled from them it may be regarded as his also.

In the second edition of the Règne Animal, Latreille divided this family into five sections.—First those with dilated tarsi and antennæ simply serrated. Of this section, which comprises the majority of the family having simple antennæ, some of the species are furnished with an evident scutellum, as *B. fasciculata* from the Cape of Good Hope. *B. vittata* and *scutellata* from India, &c.,—others are destitute of a scutellum, as *B. grandis* from South America. Some species of a linear shape, including several British insects, compose the genus *Agrilus* of Megerle; whilst others, of a short and nearly triangular form (some of which are likewise British) form the genus *Trachys* of Fabricius. Another genus, *Aphanisticus*, also British, is distinguished by its clavate antennæ. The second section, having the antennæ comb-shaped, and the tarsi nearly cylindric, comprised only the genus *Melasis* of Olivier, the type of which is likewise found in England. Since the publication of this work, however, the family has undergone revision by several authors, who have divided the species into numerous generic groups. The memoir of M. Eschscholtz, in his "Zoologischer Atlas" of M. Solier, in the "Annales de la Sociéte Entomologique de France," and the new catalogue of the Baron Dejean, may be especially noticed; but as all these new groups rest merely upon structural distinctions, without any facts relative to their economy having been added in support of their establishment, we shall not further notice them, especially as they are for the most part composed of rare and exotic species in the possession of very few entomologists.

BURCHELLIA (R. Brown). A genus named after W. Burchell, a traveller in Africa. There are two species, *Bubulina* and *Capensis*. The flowers are pentandrious, and belong to the natural order *Rubiaceæ*. The *B. capensis* is a beautiful shrub, with scarlet flowers in terminal clusters.

BURDOCK. That is, bear-dock; the *Arctium* of Wildenow. A large coarse looking plant, common on hedge banks, and sides of high-ways. The hooked scales of the calyx fix the burs on the fleeces of sheep, or on garments made of wool. The seeds are food for birds, but no domestic animal except the ass will eat the leaves. The peeled stem, while tender, may be eaten as salad, and the green plant by calcination yields a fine alkaline salt.

BURMANNIÆ. A natural order of monocotyledonous plants, containing three or four genera. It is not very closely allied to any known monocotyledonous order, but seems to approach nearest to the *Hæmodoraceæ*, or blood-root tribe.

Its characters are: flowers hermaphrodite; perianth adnate with the ovary, coloured; membranaceous, with six teeth, of which the three outer have a wing or keel at their back, while the three inner are minute; stamens three, inserted into the tube opposite the inner teeth; anthers sessile, two-celled, opening transversely; ovary inferior, three-celled, many seeded; style single; stigma three-lobed; capsule covered with the withered perianth; seeds minute and streaked.

The plants of this order are herbs with tufted radical acute leaves, and terminal sessile flowers. They are mostly tropical, and are natives of the main regions of Asia, Africa, and America. Their proparties have not as yet been investigated.

The principal genera are: *Burmannia, Tripterella,* and *Maburnia*. *Burmannia biflora* is a delicate little plant, with pale pimple flowers, found in the swamps of Virginia. *Tripterella capitata,* with its slender threadlike stem and capitate white flowers, grows in wet places, and on the borders of ponds, in Lower Carolina.

BURNET is the *Poterium* (infused in drink called cool-tankard) *sanguisorba* of Willdenow. This is a British plant, and there are two other species found in Spain and Hungary. The flowers are unisexual, and the genus is placed in the natural order *Rosaceæ*. The generic character is, barren flowers—calyx of four leaves; corolla in four divisions; stamens thirty to forty; fertile flowers—calyx of four leaves; corolla four-clefted; seed-vessels two; fruit two-celled, invested with the calyx. Burnet occurs frequently in the south of England, and has long been employed as an agricultural plant, to mix with permanent grasses in laying down pastures. It continues to grow during winter, with more vigour than any other pasture plant, and hence it gained a character which it really does not deserve. The fact is, it is not relished by either horses, cattle, or sheep; and therefore when other plants are closely grazed off, this remains in tufts untouched. It is said to be particularly palatable to deer, and if so, should be introduced into deer-parks. It is a favourite salad plant on the continent; and as we have already stated, is sometimes used in this country like borage for adding flavour to the beverage called "cool-tankard." The leaves when bruised smell like cucumbers, and taste somewhat like the parings of that fruit.

BURNET SAXIFRAGE is the *Pimpinella* of Linnæus. A family of European weeds, only noticed by botanists. The flowers are pentandrious, and the plants belong to the natural order *Umbelliferæ*.

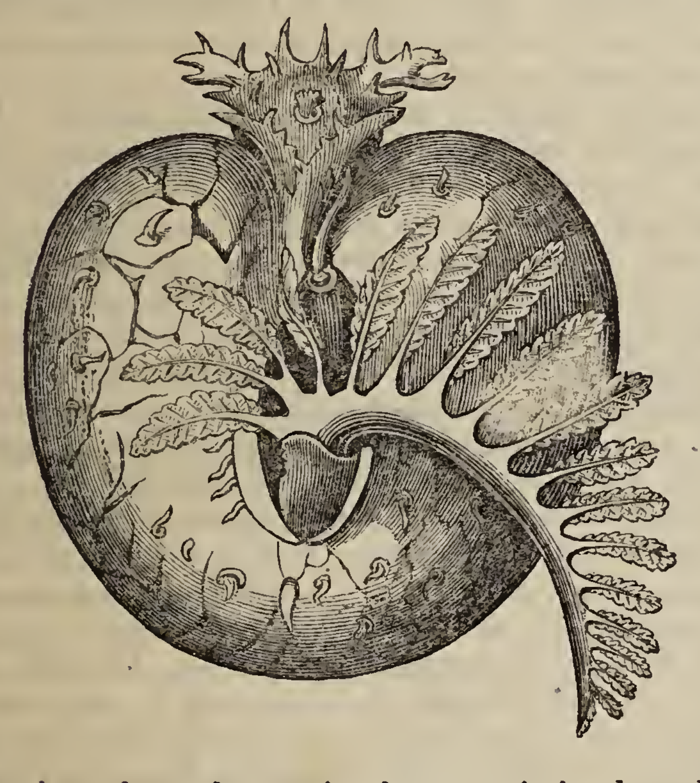
BUR REED is the *Sparganium simplex* of Willdenow. It receives its generic name from the riband-like shape of the leaves. The flowers are unisexual, both males and females sticking like burs upon the reed-like stems. All the species are found in England, and in many other countries, both in warmer and colder latitudes. The *S. ramosum* is a luxuriant growing plant, and troublesome in pools or water courses required to be kept clean.

BURS (Cammerson). A genus of spinous finned fishes, belonging to the lancet-fish family, or those which have their bodies armed with spines capable of inflicting severe wounds. They are all inhabitants of the warm seas, and feed chiefly if not entirely upon vegetables. The ventral fins of this genus have the external and internal ray in each spinous, and the three intermediate ones articulated. They have five rays in the gill-flaps, and a strong spine placed in front of the dorsal fin. The etyloid bones of the shoulders are produced and reversed, till they are attached by their extremities to the interspicuous rays of the anal fin. The species are very numerous, and they have been differently varied by different authors. They are the genus *Ampharanthus* of Black, the *Antrogastri* of Houthryn, and in part the *Sheutis* of Linnæus.

BURSARIA. A genus of the Linnæan class *Infusoria.* It is found in wet places, where stagnant water has for some time imbibed the infusion of animal or vegetable matter. It is not visible to the naked eye; but when examined under a powerful microscope, it appears a transparent membrane, excavated in the centre, with four laciniæ on the margins, of which the two lateral ones are equal and short, the anterior and posterior unequal and longer. They are mostly found in the months of July and August, in damp woody situations, near the Limnea. The *Bursaria hirundinella* is the only species described.

Under the article INFUSORIA, these wonderful proofs of Almighty wisdom will be more fully described.

BURSATELLA (Leach). A genus of molluscous animals established by Dr. Leach. It is very large, and inhabits the Indian seas. There is no trace of shell, and the animal is thus described:—the body sub-globular, the lower part offering an oval-formed space, circumscribed by thick lips, indicating the foot, the upper part with a thick edged oval slit, symmetrical and formed by a complete union of the swimming appendages of the mantle, communicating with a cavity in which are found a very large free branchia and anus, four divided and branched tentacules, besides two buccal appendages. The *B. Leachii,* here



figured, is the only species known; it is classed by de Blainville, in the *Paracephalophora,* third order *Monopleurobranchiata,* second family *Aplysiacea.*

BURSERA (Jacquin). Called after J. Burser, a botanist. There are two species, both lofty trees; one is common in the West Indies, which is called *B. gummifera,* from the great quantity of balsamic gum exuded by it; the other species is found in the East Indies. They belong to the natural order *Terebinthaceæ.*

BURSERACEÆ. Balm of Gilead tribe. A natural order of dicotyledonous plants, containing eleven known genera, and upwards of forty species. The *Burseraceæ* are closely allied to the *Anacardiaceæ,* or cashew tribe, but differ from them in their compound ovary and pinnated leaves. By many authors they are considered as a section of the *Terebinthaceæ.*

The essential characters of the order are: flowers hermaphrodite, sometimes unisexual; calyx, having from two to five divisions, persistent; petals varying from three to five, inserted below the calycine disk; stamens twice, rarely four times, the number of the petals; ovary two to five-celled, superior sessile; fruit, a drupe; seeds without albumen.

The plants included in the order are trees or shrubs, with alternate unequally pinnated leaves, and axillary or terminal flowers growing in racemes or panicles. They are natives solely of the tropical regions of Asia, Africa, and America, and are propagated by cuttings, layers, and seeds.

Most of the genera of this important order furnish fragrant balsamic resin, possessing more or less stimulating properties.

The genera are: *Bursera, Boswellia, Balsamodendron, Icica, Canarium, Colophŏnia, Protium, Hedwigia, Sorindeia, Garuga,* and *Marignia.*

Bursera, named after Joachim Burser, formerly Professor of Botany at Sara, in Naples, is the genus whence the order has been designated. *Bursera paniculata,* or *Colophonia Mauritiana,* called *Bois de Colophane,* in the Isle of France, yields, by incision, a copious limpid oily fluid, having an odour of turpentine, which, by drying, acquires a butyraceous consistence, and has somewhat the appearance of camphor. Like camphor, it burns with a vivid flame, and leaves no residuum. *Bursera gummifera* is a large lofty West Indian tree, with a fine leafy head, and a smooth trunk, covered with a thin brown or greyish epidermis, which peels off in shreds like the European birch; hence the tree is sometimes called *Jamaica Birch-tree.* It yields a resin called *chibou,* having an odour like turpentine. The balsamic fluid produced from this tree is used in America as an external application to wounds in the same way as the balsams of the East. The root, which is said to be bitter and tonic, and to resemble the *Quassia simaruba* in its properties, has been prescribed with success in various fluxes. Hedges are made of this plant by the Spanish residents in South America. *Bursera acuminata* yields a yellow concrete essential oil, which is not put to any particular use.

Boswellia, another genus of this order, has been named in honour of Dr. John Boswell, of Edinburgh. *Boswellia serrata,* of Roxburgh, *Libanus thurifera,* of Colebrooke, yields the gum resin called *olibanum.* This substance was formerly supposed to be the product of the *Juniperus Lycia.* It is said to ooze spontaneously from the bark, and is collected in Arabia, and brought from Mecca to Cairo, whence it is imported into Europe. It is also procured from the East Indies. In commerce it occurs in the form of grains of different sizes, of a red or yellow colour, having a peculiar aromatic odour, and a bitterish pungent taste. With spirit it forms a transparent solution; but when triturated with water, it forms a milky fluid. It is inflammable, and is said to be the true frankincense of the ancients. It is still used as incense in Roman Catholic churches. It possesses stimulant, astringent, and diaphoretic properties, and was formerly prescribed in affections of the head and chest, in coughs, spitting of blood, and various fluxes. It was also employed in fumigations, as a perfume in sick-rooms, and externally as an application to wounds. It was formerly an ingredient of the famous Friar's balsam. It is now chiefly used in forming the frankincense plaister which is applied in cases of weakness of the large muscles, as of the loins. The resin of *Boswellia glabra* is used in India as frankincense, and is administered by the native practitioners in various diseases. When mixed with coarse oil, it is used for pitching ships. The wood of the tree is heavy, hard, and durable, and has been employed in ship-building.

Another genus of the order is *Balsamodendron*, which furnishes several important resinous substances. *Balsamodendron Giliadense* yields the liquid resin called Balm of Gilead. This tree grows in Arabia, on the Asiatic side of the Red Sea, near Mecca. It appears to have been cultivated in very early times, and frequent allusion is made to it in Scripture. Thus it is stated in Genesis, that the Ishmaelites who purchased Joseph "came from Gilead, with their camels bearing spicery, and balm and myrrh;" and balm is noticed among the substances which Jacob ordered his sons to take as a present to Joseph. The prophets, Jeremiah and Ezekiel, also mention the balm of Gilead as being held in high repute. Pliny states that this resin was brought to Rome by the generals of Vespasian. According to Josephus, the balm-tree was first carried from Arabia to Judea by the queen of Sheba, as a present to Solomon, where, being afterwards cultivated for the sake of its fragrant medicinal juice, particularly on Mount Gilead, it acquired the name of Balm of Gilead, or *Balsamum Judaicum*.

The balm is procured from the tree by incisions in the bark and branches, and also by the decoction of the leaves and young branches in water. It is furnished in very small quantities, and hence generally commands a high price when pure. It is very liable to adulteration. It has a strong pungent odour, an aromatic bitter and astringent taste, and, when fresh, is of a bright yellow colour. The balm was formerly highly esteemed on account of the many miraculous cures which it was said to effect. In Egypt it was looked upon as a panacea, and was prescribed in wounds, ulcers, poisonous bites, nervous and pulmonic diseases, as well as in affections of the stomach. It is still looked upon by the Egyptians as an antidote to the plague. Mahomet affirmed, that a grove of balm trees sprung up from the blood of his own tribe killed in battle, the juice of which cured the wounds of the faithful, however deadly. The wonderful properties ascribed to this resin are not entitled to much credit, and it is now nearly discarded from European practice, as being in no way superior to the balsams of Canada and Copaiba. By eastern nations, however, it still continues to be valued as a medicinal agent, and as an odoriferous unguent. In Turkey it is prized as a cosmetic. The Turkish ladies, after having been in a hot bath, anoint the face and breast with it, and repeat the process every third day for a month. Oil of almonds, and other cosmetics, are then rubbed over the parts, and thus the complexion is said to be greatly improved. Lady Mary Wortley Montagu tried this cosmetic, but suffered severely from the swelling, redness, and pain which it occasioned.

The dried fruit of this tree was formerly sold under the name of *Carpobalsamum*; it entered into the composition of the celebrated Mithridate. The dried twigs, called *xylobalsamum*, are burned in temples, and in the palaces of Sultans.

The balsam of Mecca is the product of another species of *Balsamodendron*, which has received the name of *Opobalsamum*. This resin is similar to the balm of Gilead, but is said to be purer and much more valuable. All the properties ascribed to the latter are said to reside in a still greater degree in the balsam of Mecca. The value of this balsam may be judged from the fact, that it is considered a great privilege of the Governor of Cairo to receive one pound of it yearly.

Balsamodendron Kataf, formerly *Amjus Kataf*, a native of Arabia Felix, appears to be the tree which yields the gum-resin commonly known by the name of myrrh, and which is imported into this country from the East Indies. Though this substance was well known to the ancients, and is frequently mentioned in Scripture, still great obscurity lies over the tree which produces it, as well as the mode in which it is procured. Myrrh is met with in commerce in the form of irregular, fragile, and semi-transparent grains of a reddish-yellow colour, having an agreeable odour, and a bitter aromatic taste. It consists of resin, essential oil, and gum. Alcohol extracts that part in which its bitterness, virtues, and flavour reside.

Myrrh was used for various purposes by the ancients. The native practitioners in India order it in cases requiring cordials. It is much more used in Britain than in France. In doses of six or ten grains it is tonic, promotes digestion, and increases the appetite. In larger doses it is stimulant, and is prescribed in asthma and chronic catarrh. It is often combined with other tonics, and with purgatives, such as aloes. In the form of tincture it is used as a gargle, as an application to foul ulcers, and as a wash for the teeth and gums.

Icica is another genus deserving notice. *Icica heptaphylla* furnishes the resin called *Elemi*. This resin formerly came from Egypt and Ethiopia, in masses of two or three pounds, wrapped up in palm leaves. It is now imported in tin cases from Brazil, New Spain, and the warm regions of America. The resin is got by incision into the bark, and occurs in semi-transparent masses of a yellowish colour, having a strong odour, somewhat like fennel, and a hot bitter taste. It consists of resin, a bitter extractive matter, and an essential oil, to which its odour is owing. It is a stimulant, and is chiefly used externally in the form of plasters and ointments. It is an ingredient in the balsam of *Fioraventi* and the liniment of *Arcæus*, or the compound ointment of *Elemi*. The resin got from two other species of icica, viz., *Icicariba* and *Carana*, is very similar to elemi, and is often mixed with it. *Icica heterophylla*, or *Acuchini*, furnishes the balsam of *Acouchi*. The exudation from *Icica Guianensis* is made into a varnish. This tree is called in Cayenne *Bois d'encens*. The stimulant tonic resin called *Tacamahac*, which is generally procured from the *Fagara octandra* and *Populus balsamifera*, is also obtained from one of the species of *Icica*.

Canarium commune, another of the *Burseraceæ*, is a resinous tree found in the Molucca Islands and New Guinea. It yields a balsamic substance similar to *Copaiva*. The nuts of this tree are eaten by the inhabitants of Java and Celebes, either raw, or made into a kind of bread, and an oil is expressed from them which is used as an article of diet, and also as a means of giving light. The nuts, when eaten raw, are said to be apt to produce dysentery. The fruit of the *Canarium oleifolium* is also eaten, and an oil is expressed from it. The bark of this plant, when wounded, yields a resin similar to copal, which is used as a varnish. The substance called *Damar*, in the East Indies, and employed for caulking ships, is made from this resin, mixed with powdered bark of bamboo and chalk.

The wood and juice of various species of icica and canarium are used for perfuming apartments, and burning in temples.

BUSTARD (*Otis*). A very interesting genus of birds, arranged by Cuvier as the first of his *Pressirostral* family of the order of *Echassiers*, "stilt," or long-legged birds; for a general account of which see the article Bird in this work.

The characters of the genus are these: they have the massive body of the gallinaceous birds, only their legs and necks are much longer in proportion. Like the gallinidæ, they have the bill of a mean length, slightly compressed, slightly arched in the culmen of the upper mandible, a little incurvated at the tip and projecting over the under one. They have also short membranes between the toes in the same manner as the gallinidæ. In other respects they, however, differ, and resemble more the other long-legged birds which frequent dry pastures. They have the naked legs of these; and their whole anatomical structure agrees more with them than with the gallinaceous birds, and even their flesh has the same flavour. Like them also they are without hind toes, and the smaller species have a very considerable degree of resemblance to the plovers. Their tarsi are reticulated, their wings are short for the size of the birds, and they do not fly much unless when they are alarmed. Their ordinary march is on foot, and when they run swiftly they use their wings partially raised for balancing themselves. They are very miscellaneous in their feeding, eating indiscriminately, seeds, green vegetables if they are succulent, insects, and worms.

There are several species, most of them inhabiting countries which are warm and temperate, and where they can range undisturbed. Though there is a very great difference in the sizes of the species, there is a very remarkable correspondence in their manners, —enough to characterise them as a well marked genus, and perhaps even family; for there are no other birds which resemble them very closely. There is one species still a resident though a very local resident in some parts of England, and there is another which occasionally makes its appearance as a visitant; and from some notice of them, a general idea of the manners of the genus may be obtained.

I. The Great Bustard (*Otis tarda*). The name *tarda*, or slow, is very incorrectly given to those birds, for they are far from slow on foot, and though they are reluctant to take the wing, they are not bad fliers when they have once taken it, neither have they that difficulty in getting on the wing, which has sometimes been alleged. That they take long migratory flights is certain, because we have well authenticated accounts of straggling bustards being found at the distance of four or five hundred miles from any place where they are known to be resident,—as for instance, there was one shot in the lowlands of the county of Moray, in Scotland, in the year 1823, though it is pretty clearly made out that there could not be any resident ones in the island at that time, nearer than the county of Norfolk; and it is very probable that the straggler found in Moray came not from Norfolk, but from the continent, and that it must have crossed the German ocean upon one stretch of flight.

The great bustard is truly a magnificent bird, the largest of all the native birds, not only of the British islands but of Europe. The male bird, when full grown, is at least four feet in length, and not less than nine in the extent of the wings,—so that it is really a well-winged bird for its size and weight. Not equal to many of the air birds certainly, but still well-winged as compared with the majority of low-flighted birds, whose natural place of abode is on the level surface of the earth, and which use the wing only when they are raised by terrestrial enemies, or compelled to shift their quarters by want of food, or any other cause.

The bill is of a sort of ashen grey colour; but the legs, which are covered with reticulated scales, and not feathered down to the tarsal joints have a garter or naked space above, are black. The tarsi is about half a foot in length; the tibia is also long and comparatively free, and well supplied with muscles. There are only three toes, all turned to the front; and there is an elastic pad on the lower part of the tarsus which answers as a heel,—the structure of the toes being well adapted for giving a spring to the foot when raised in walking, and also for receiving the weight of the bird when the foot is planted, without any concussion to the body. The march is thus firm and stately, and performed with the alternate foot without any hopping.

The colours are not gaudy, but the plumage is warm and rich, and the markings very beautiful, and even elaborate. The head is silver grey, with a very well defined streak of black along the middle. In the male bird, there descends from near the angles of the gape, or rather from the ear coverts, two pendent tufts of black silky feathers, which hang for eight or nine inches down the sides of the neck. These pendent tufts of feathers play backwards and forwards on the sides of the neck, as the position of the head is shifted, and alternately display and conceal two patches of naked skin on the sides of the neck which are of a violet colour, more intense in the pairing time of the birds. The lower part of the neck passes into a reddish orange, of a rich but rather subdued tint. The ground colour on the back is nearly the same; but it passes into greyish on the scapulars; and there is a greyish tuft of downy feathers at the setting on of the neck. The whole of the orange feathers are very elaborately streaked, barred and mottled with black. The greater coverts of the wings and some of the secondary quills are of a dull black colour; but the primary quills are brownish black with white shafts. The feathers of the tail have some white at their bases, and generally also at the tips; but the principal part of them is rich brown with black lines, which form a regular band. The black markings on the feathers are in general regular crescents, with their convexity toward the point of the feather, and a small line of the same colour running parallel to it. On the fore part of the neck, in the male, there is a membranous sac or pouch, having its opening under the tongue, and capable, when distended to its full stretch, of containing at least two quarts. This pouch is not covered with feathers, but with a naked elastic skin of a bluish black colour. There have been many conjectures as to the use of this pouch in the economy of the birds, but they are far from satisfactory, and the point remains undecided,—it is not understood ever to contain any liquid. It has been considered as a reservoir for water; but bustards drink very little, if they drink at all; and the usual stories of animals carrying water in any reservoirs within their bodies, either for their own supply or for that of their young or any one else, have no better foundation than the now exploded error, that water for the supply of travellers in the desert can be had from the reticulated portion of the compound stomach of the camel.

The female bustard wants this pouch, as also the pendent feathers and the violet-coloured naked skin on the sides of the neck. She is not half the size of the male, or exceeding it, and her colours are rather different. The grey upon the head and scapulars is darker; the mottlings with black are smaller and more uniform, and they are continued on the feathers of the tail in place of the definite black hue which is drawn upon that of her mate. She lays her eggs upon the ground with little or no formal nest, as is the case with the gallinidæ, and also with those long-legged birds which the bustards most resemble in other respects. The female bustard is a very close sitter during her incubation, and can with great difficulty be raised from her eggs. There are in general only two for a brood, produced early in the season, and the time of sitting on them extends to about four weeks. The young are, at first, wholly covered with down of a pale yellowish brown colour, mottled with darker brown and black: and they follow the birds which have the chief resemblances to the bustard in other respects, in being able to follow their mother, and to pick up their own food as soon as they break the shell. Until they are fledged and able to take to the wing, they seek their safety from enemies by squatting closely among the clods, which they resemble in colour. When bustards are fledged, they always seek to escape from ground enemies by flight; and therefore the old stories which are told of the sport obtained by coursing them with greyhounds cannot be true.

The small remnant of those birds which is left in England is found chiefly, if not exclusively, in the county of Norfolk, but they summer and winter there, and are not migrant birds. The extensive corn fields, where there are few trees or enclosures, are their favourite haunts in the breeding season, and generally till the harvest comes on; and after that they retire to the fields of turnip. They are much more abundant, and also more migrant, on the continent of Europe than they are in England; but they always prefer dry flats to marshy ones, and in those places which are subject to heavy periodical rains they shift their quarters.

The Little Bustard (*Otis tetrax*) is much smaller than that species of which a very short account has been given. It is not much more than one-third of the length, and its wings are shorter in proportion, but it is a stouter and weightier bird in proportion to its lineal dimensions. The upper part is brown, mottled with innumerable small spots of black, and the general tint of the under part is white, with spots of black. The male has a tinge of rose colour on the breast, and, when full grown, a black collar round the neck, with white margins. This collar is wanting in the female and immature birds and in the adult male, both it and the rosy tint on the breast are most conspicuous during the breeding season. Though rare in Britain, this species is met with plentifully in the dry and warm parts of southern and eastern Europe.

Ruffed Bustard (*Otis houbara*). This species is a native of Arabia and the north of Africa. It is about the size of the common fowl, but the body is larger in proportion, and better fitted for running. The prevailing colour is pale yellowish brown, with black; there is a pendent crest of white feathers on the head, and a ruff of produced and erectible feathers on the side of the neck, which are of a dull white colour, marked with black lines.

There are various other species in Africa and India, but they have nothing peculiar in their manners as differing from those already mentioned, and many of them partake so much of the characters of some of the plover family, that it is not easy to draw a line of distinction between them.

BUTCHER'S BROOM is the *Ruscus* (box-holly) of Linnæus. The English name is derived from the custom of butchers frequently making besoms of it to sweep their blocks. It belongs to the Linnæan class and order *Diœcia Monadelphia*, and to the natural order *Smilaceæ*. The generic character is: calyx of the males in six sepals; corolla none. Females,—rudiment of the ovary oval, perforated at the end; style one; berry three-celled: seeds two. This is, though a humble, a very curious plant: it has thick, white roots, and sends up a plurality of stems, which are half shrubby. It has numerous leaves armed with sharp prickles at the points. The flowers of some species are borne on the upper surface of the leaf; on others on the under side: the *R. androgynus* bears the flowers on the edges. The female flowers are followed by fruit resembling small cherries, each containing two seeds. All the species are readily increased by suckers.

BUTEA (Roxburgh). Named in honour of John, Earl of Bute, a great patron of botanists. It is a genus of three species of East Indian trees. They are decandrious, and belong to *Leguminosæ*. Generic character: calyx bell-shaped, with five teeth; vexillum lance-shaped, and somewhat reflexed; pod on a footstalk, smoothly compressed, membranaceous, not bursting, having one seed at the point; seed large and flat. These trees, like almost all the order to which they belong, bear splendid flowers, and are also useful to man. From *B. frondosa* is obtained the *gum lac* of commerce. Infusions of the flowers, impregnated with a solution of alum, or of alum and tartar, dye cotton cloth of a beautiful yellow colour.

BUTIRINUS. A genus of malacopterygeous, or soft-finned fishes, with abdominal fins, belonging to the herring family. They are very abundant in the warmer seas, and there are a good many species, as well as abundance of individuals, of each. They have the silvery appearance of the scales, which is characteristic of the family, and, like all the rest, they are esculent and wholesome. Their jaws are formed like those of the herring, but their bodies are longer and rounder. They have the snout projecting something in the manner of the anchovies, and the opening of the mouth not very deep. Their most distinguishing character is having teeth arranged in raised spots and lines both on the tongue and the palate. So far as their manners are known, they do not appear to differ materially from those of the common herring. Indeed, all the family have a great resemblance to each other in this respect, though they differ a good deal in geographical position, in the size of the individuals, and in the flavour of their flesh.

BUTOMEÆ. The flowering-rush tribe. A natural order of monocotyledonous plants, containing two genera and five or six known species. The genera included under this order are by many authors referred to the Alismaceæ, to which they are closely allied, but differ in the mode in which their seeds are attached.

The characters of the order are, calyx having three divisions, which are usually herbaceous ; petals three, coloured ; stamens, definite or indefinite, hypogynous ; ovaries varying from three to six or more, more or less free or united ; follicles many seeded, distinct and beaked, or united into one mass ; seeds very minute, attached to the whole inner surface of the pericarp by a sort of vascular network ; no albumen.

The plants belonging to this order are aquatic, having cellular leaves furnished with parallel veins and handsome umbellate flowers of a yellow or, purple colour. They are natives of the marshes of Europe, South America and the East Indies.

The genera of the order are *Butomus*, *Limnocharis*, and *Hydrocleys*.

Butomus umbellatus, common flowering rush, is frequent in the ditches and ponds of England and Ireland, and grows in Duddingstone Loch, near Edinburgh, and the Loch of Clunie in Scotland. It is highly ornamental, and is interesting as being the only British plant in the ninth class *Enneandria*, of the Linnæan system. Another species, *Butomus latifolius* is found in Nepal. These plants are said to possess acrid properties.

Limnocharis plumieri is found in the marshes of Brazil. Its flowers are yellow, and its leaves have a singular hole at their apex, which seems to be intended as an outlet for the moisture which constantly distils from the plant. A milky juice is yielded in great abundance by this plant.

BUTOMUS (Linnæus). So called from *bous* and *temno*, cropped or cut by oxen. A genus of two

species, one British, the other from Nepal. Class and order *Enneandria Hexagynia*, and natural order *Butomeæ*. Generic character: calyx none; corolla six-petalled, three outmost smaller, withering; stigma abrupt; capsules six, oblong, taper, each one-celled; seeds many. This is the flowering rush of our rivers, and is an elegant plant, having its flowers in an umbel four or more inches in diameter; each flower is about an inch broad, of a fine rose or purplish white colour. Professor Lindley thinks it the most beautiful of all our native plants; adding—that the number three is evidently predominant in the fructification: the corolla being doubly tripetalous, the stamens thrice three, the seed-vessels six, in a hexagonal form, and the involucre three-leaved. The quaint description of old Gerard, in his Herbal, deserves to be for the hundredth time reiterated. "The water-gladiole, or grassie-rush," says he, "is of all others the fairest and most pleasant to behold, and serveth very well for the decking and trimming up of houses, because of the beautie and braverie thereof." The annexed cut gives an idea of the umbel of flowers.

BUTTER BUR is the *Tussilago* (good for a cough) *petasites* of English botany. It is called petasites, specifically, because of its very broad leaves affording a shelter from rain to poultry and other small animals. It is called butter bur in allusion to a former application, and pestilent wort, from its supposed efficacy in the plague. The plant is syngenesious, and belongs to the order *Compositæ*.

BUTTER CUP is the *Ranunculus* (frog-wort) *bulbosus* of Willdenow. It is the plant which gilds our meadows with its glossy yellow flowers in the months of May and June. Like most of its congeners it possesses the property of inflaming and blistering the skin; hence the roots have been applied for that purpose, particularly to the joints, in cases of gout. Besides the name butter-cup, it is also called butter-flower, king's-cups and crow-foot; and it is "the cuckoo-buds of yellow hue" of Shakspeare.

BUTTERFLY. The ordinary English name of a very extensive * group of insects belonging to the order *Lepidoptera*, and corresponding with the great division *Diurna* of Latreille, or the Linnæan genus *Papilio*.

Who has not been struck with the elegance and beauty of these delicate insects,

> "Which flutter round the jasmine stems
> Like winged flowers or flying gems"?
> MOORE'S LALLA ROOKH.

Who has not watched them hovering and fluttering over the flowers which they more than rivalled in splendour of colour, or seen them at length resting with a touch so light as not to appear to be there?

> "Proles arbusti, papilio ut forem,
> Violas et lilia et rosas halens,
> Erraticus usque de flore ad florem
> Quæ pulchra, quæ suavia sunt, osculans."
> *Archdeacon Wrangham's elegant Translation of the Song "I'd be a Butterfly."*

Who has not observed them, when at last reposing on the bosom of a flower, opening and shutting their beautiful wings to the summer's sun, alternately erecting and depressing their long and slender antennæ, which, by a fanciful idea, have been generally termed horns.

* The number of species of butterflies is far greater than would be supposed. Latreille has described not less than 1804 species in the Encyclopédie Méthodique; of this number about 237 are natives of Europe, the rest are extra European. If, however, it is considered that out of Europe the entomological treasures of the globe are but very incompletely known, and supposing that even one-third of the diurnal lepidoptera were unknown to Latreille, the number is raised to about 2500, of which number 260, or one ninth part, are inhabitants of Europe.

"Two deadly weapons first he bore,
Strongly outlanced towards either side,
Like two sharp spears his enemies to gore—
So did this fly outstretch his fearful horns,
Yet so as him their terror more adorns."—SPENSER.

Or, lastly, who has not perceived the beautiful spiral apparatus which they employ in extracting the nectar of flowers?

We do trust that there are many amongst our readers who have been sufficiently imbued with the spirit of observation to have noticed these things, since they will thereby have attained a knowledge of the chief characters by which this beautiful group of insects is distinguished from the other lepidopterous tribes.

"The velvet nap which on his wings doth lie,
The silken down with which his back is dight,
His broad outstretched horns, his airy thighs,
His glorious colours and his glistening eye."—SPENSER.

We have hitherto, however, seen the butterfly only in its final and glorious state; let us now look at it in the earlier stages of its life. "Were a naturalist to announce to the world the discovery of an animal, which for the first five years of its life existed in the form of a serpent, which then penetrating into the earth, and weaving a shroud of pure silk of the finest texture, contracted itself within this covering into a body without external mouth or limbs, and resembling more than any anything else an Egyptian mummy; and which, lastly, after remaining in this state without food and without motion for three years longer, should, at the end of that period, burst its silken cerements, struggle through its earthy covering and start into day a winged bird, what, think you, would be the sensation excited by this piece of intelligence?" In this striking manner do the authors of the Introduction to Entomology introduce the interesting subject of the metamorphoses of insects, a subject which, from the numberless variations in which it is to be observed, merits the most fixed attention.

The butterflies, indeed, rarely enshroud themselves in a cocoon, but the measures which they take to supply its want are far more remarkable, even than the formation of a silken case spun from the mouth.

The female butterfly deposits her eggs upon such plants as are proper to nourish the caterpillars which proceed from them; thus the common white butterflies place them upon cabbages, the tortoise shell and peacock butterflies upon nettles, &c. These eggs are simply attached by some glutinous secretion to the leaves or stems, without any of that curious precaution of inclosing them in down, which takes place in some species of moths.

The caterpillars which are disclosed from these eggs are for the most part, at first, of a dark colour, previous to their first moulting, which takes place at the end of several days after their birth; after this event, however, they appear with their respective colours. They are of a long and cylindric form, composed of twelve segments, exclusive of the head, and with nine spiracles on each side. Some are slightly hairy, others quite smooth, and many have simple or branching spines upon the different segments of the body. The majority are furnished with sixteen feet, of which six are scaly and attached, in pairs, to the three first segments, and the remaining ten are membranous. In the three anterior pairs of legs are inclosed the rudimental legs of the future butterfly. During their growth, and before arriving at their full size, they shed their skin several times, an operation which, although perfectly natural, and which only lasts in general three or four minutes, is often exceedingly painful, and causes the death of some caterpillars, which, owing to some circumstance or other, do not possess sufficient strength to accomplish it. At this period of its existence, its head is furnished with a pair of very powerful horny jaws almost of a triangular form; a pair of lower fleshy jaws, and a fleshy lower lip united to the latter, and furnished with a curious apparatus for spinning silk. The sides of the head are likewise furnished with twelve simple and globular eyes, exceedingly minute, scarcely perceptible, and totally unlike the eyes of the future butterfly. It now feeds voraciously upon leaves, gnawing them to pieces with its powerful jaws. Having, however, arrived at its full size, and being in this state incapable of reproducing its species, it now prepares for those singular changes of form and functions, which are destined to end in the production of a creature perfect in its kind. It now ceases to eat, voids whatever portion of its food remains unassimilated, quits the leaves, and seeks a secure situation in which to undergo its inactive and helpless state. We have said that the majority of the chrysalides of butterflies are not inclosed in a cocoon, few of them likewise descend to the ground to undergo their transformations. How then can an animal, having completely cast off its outer covering, furnished with legs, and appearing in a state in which the rudiments of legs are completely soldered to the body and incapable of rendering the least assistance, support itself from falling to the ground? This is a problem which it would be most difficult to solve, and yet the difficulty is overcome by the caterpillars in several different manners, and which depend in a great measure upon the position in which the future chrysalides are destined to be placed; some being suspended in the air vertically, head downwards, the tip of the tail being the only point of attachment to a twig or leaf; others, on the contrary, are attached against walls, &c., having the head higher than the tail, and many are placed horizontally, these being attached not only by the tail, but by a skein of silk passing across the middle of the body. It is to Reaumur that we are indebted for a precise account of the manner in which the different manœuvres employed by these caterpillars are effected. We will notice first the manner in which the suspension of chrysalides is performed, a process which may be observed by every one in the common tortoise-shell butterfly, which is found upon every bed of nettles. Reaumur asks how is the circumstance to be accounted for, that the chrysalis is found hanging precisely in the same place as we had observed the larva suspended,—seeing that when the latter is attached, every portion of the chrysalis is covered by the skin of the larva; it is therefore the tail of the caterpillar which we had seen attached in the very same spot where we now perceive the tail of the chrysalis. It might be imagined that the skin of the caterpillar was slit from the head to the tail, or that the tail of the chrysalis had, in some manner, been protruded through the skin of the caterpillar; but neither of these circumstances takes place: the skin of the latter only bursts a short distance down the back, and the tail of the chrysalis is entirely concealed within the envelope of the caterpillar. Moreover the difficulty is increased by the threads to which the tail of the chrysalis is suspended, being spun by the mouth of the caterpillar.

The proceedings of the caterpillar are, however, of the most simple kind. It first proceeds to form a small conical mass of silken threads, which it spins from the mouth; this mass, however, instead of being smooth and entire, is loose, and but slightly woven together. It now proceeds to seize hold of this button of silk with its hind pair of legs, which instead of terminating in a single claw like the six fore legs, are, as well as all the four other posterior pairs, armed with a vast number of very minute curved hooks, which therefore are well fitted to seize the loose threads of the silk button previously formed. When this is effected and the legs firmly fixed, the fore legs of the insect quit their hold, its body falls in a vertical direction, and the larva appears to be suspended by the tail, the hind legs being placed at the extremity of the body.

Shortly afterwards, however, it raises its head a little, which gives a curve to its back, and this motion is repeated until a slit is made behind the head, and which is increased by degrees along the back, until the insect is enabled to extricate by muscular contraction the anterior part of its chrysalis form from within the skin of the latter. Now this lower part is broader than the upper, which gradually decreases in size, so that the exuvia easily slides upwards towards the tail, the chrysalis alternately extending and contracting its body. This alone would be sufficient to cause the exuvia to mount towards the attached legs, but its movement is favoured by the angular projections of the body of the pupa, which, as they point towards the tail, prevent the skin from slipping down again; they are, in fact, cogs acting like the cog-wheels of our machinery. By degrees, therefore, the old skin of the larva is pushed upwards, until its folds are pressed together into a very small space, and it appears like a small bristly mass surrounding the tail of the chrysalis. The situation of the insect has now become critical, since, notwithstanding its tender state, it has three steps still to take, each of which seems pregnant with danger. First, the chysalis is compelled to suspend itself for a time to the insecure, yet still attached, shrivelled skin of the larva: secondly, it is necessary for it to withdraw itself even from this support, and to attach itself to the silken mass; and thirdly, it has to rid itself of the mass of exuvia, which would not only embarrass, but also hurt it, from its spiny state. The first step is effected by the pliability of the terminal rings of the body, by which, being attached together by membrane, the insect is enabled to form a kind of pliers, so as to seize a part of the exuviæ, whereby a resting place is obtained, which enables it to withdraw the extremity of its body from within the skin. Still the most difficult part of the process remains to be performed; retaining hold, therefore, of the shrivelled skin, it is enabled, by the elongation of the same membranous connexion of the segments, to extend its tail upwards, and, by the assistance of various minute hooks at the extremity of the body, to attach itself to the little mass of silk. This is indeed so delicate and perilous a step, that the insect, even after redoubled efforts, has sometimes been unable to hook itself in this manner, and has consequently fallen to the ground. This, however, only takes place with those which having been stirred during the first part of the process, have not spun a sufficiently large button of silk. In a natural state, this of course does not occur; and we can scarcely avoid wondering how an animal, which performs this intricate manœuvre but once in the course of its life, should do it so perfectly. "On en conclut," adds Reaumur, "necessairement qu'il a été instruit par un grand Maitre." Having, however, attached itself by the tail, it proceeds to get rid of the shrivelled skin of the larva, by first bending the terminal portion of body into the form of the letter S, and then giving the whole a sudden jerk, causes both its body and the slough to spin round eighteen or twenty times; as, however, the latter is further removed from the centre of gyration than the extremity of the body, it is evident that the attaching threads of the slough must suffer a greater strain than those of the chrysalis; consequently, the former, or more probably, the hooks of the legs, give way first. This is no sooner perceived by the chrysalis than it resumes its vertical position, and the skin drops. If, however, the first series of pirouettes does not prove successful, another in the opposite direction is tried; but if, after repeated efforts, it is unable to tear off the slough, it quietly submits to an evil which it cannot remove.

Such are the steps pursued by the caterpillars of a great number of butterflies, including, amongst the English species, the tortoise-shell, red and white admiral, the frittillaries, Camberwell beauty, purple emperor, &c., all of which are pre-eminently distinguished by their powerful flight and splendour of colouring, and which form the family of *Nymphalidæ;* but most of the other butterflies forming the families *Papilionidæ*, or true-tailed butterflies, white butterflies, &c., *Lycænidæ*, or the blues and copper butterflies, not only attach themselves by the tail to the stems of plants, &c., but the caterpillar fastens a skein of silk across the middle of the body previous to assuming the chrysalis state. The mode in which this is spun from one side of the body to the other (being attached on each side to a small mound of silk), differs in different species; some having a flexible body, merely throwing the head of the caterpillar over the back, and passing it repeatedly from side to side until the skein is sufficiently strong; whilst others, having a body less pliable than the preceding, adopt a method somewhat similar to that by which a skein of silk is wound upon the hand—the caterpillar first attaching a thread on one side of the body, and then carrying it over to the opposite side, forming a loop about twice the size of the body by holding the threads open with the assistance of its fore legs. Sometimes, however, notwithstanding all the care of the caterpillar, the threads will slip off its legs, whereupon it endeavours, with surprising patience, to replace them; but, notwithstanding every contortion, sometimes in vain.

Unlike the caterpillars of some species of moths, those of very few butterflies have been ascertained to be social; examples of the spirit of sociability, however, occur in the peacock and tortoise-shell upon nettles, and also in one of the frittillaries upon the plantain, but their nests are of very slight texture. The most perfect instance of sociality amongst butterflies is recorded in the first number of the Transactions of the Entomological Society just published, in the case of a gregarious nest-making butterfly found in Mexico. Mr. Hardy, who also appears to have noticed this species, describes the nests as being inclosed apparently in white paper bags, in the manner of grapes in England, to preserve them from birds and flies. He had the curiosity to examine one of these, which he found to contain numberless caterpillars.—(Travels in Mexico, p. 32.)

The caterpillars of the Hesperiidæ, or skipper butterflies, differ from those of the other butterflies by spinning a web-like covering of silk; whilst that of Doritis Apollo is still more different, since it encloses itself in a kind of cocoon formed of numerous leaves woven together with silken threads; but the chrysalides of the majority of butterflies are naked, of angular form, some having the head terminated by two short and conical horns, whilst others have this part prolonged into a point. Different parts of the body likewise present various eminences, of which the number, form, size, and arrangement, differ materially. Many species of butterflies are in this state remarkable for the brilliancy of the golden or silvery spots with which they are adorned, whence, in fact, the names chrysalis and aurelia, by which they have been distinguished, are derived. See the article Aurelia.

The newly-formed chrysalis of a butterfly, when opened, is found to contain only a mass of pap or soft substance, in which no trace of the limbs of the future butterfly can be observed; yet we are able to perceive, in the external covering of the chrysalis, all the external organs of the future butterfly, in a very short period after the skin of the caterpillar has been cast off. Indeed Swammerdam (whose incomparable dissections of various insects in their different states, induced our celebrated English naturalist Ray, in his "Wisdom of God in the Works of the Creation," to place him at the head of those observers who had, by their exquisite investigations, completely overthrown the doctrine of spontaneous generation) very plainly demonstrated, that even before the period when the caterpillar is ready to become a chrysalis, all the organs of the butterfly might be discovered within the body of the former, thus satisfactorily showing that the chrysalis is no other than "a beautiful and orderly external representation of such limbs of the caterpillar as have grown under its skin; for though the limbs now mentioned may be seen under the insect's skin at the time it crawls and eats, in the form of a caterpillar, nevertheless it is in this state, on account of their extreme tenderness and delicacy, a very difficult matter to have a satisfactory view of them. They are, in fact, as fluid as water, and they lie folded up in many very tender membranes, interwoven with pulmonary tubes."

Hence, too, the incorrectness of the application of the terms metamorphosis or transformation (implying, as they certainly do, supernatural changes, similar to those described in the fables of the old classic poets) to the various stages of development exhibited by an insect in its passage to the perfect state, will be at once perceived. Swammerdam was indeed so well aware of the impropriety of this, that we find him, so long ago as the close of the seventeenth century, observing, "The particulars here named being rightly understood, the change, or, to express it more properly, the growth of the creature from the caterpillar state into an aurelia, cannot but appear plain and intelligible; for the whole operation consists in this, that the caterpillar casts its skin and shows the parts which hitherto lay concealed, unfolds its limbs, and arranges each in its right place with great regularity and order. This is the whole operation to which so many authors have substituted a monstrous metamorphosis, or absolute change of one creature into another, not to be found any where but in their own misguided imaginations. What wonder then, if, in their vain and idle attempts for some hundred years past, to explain this metamorphosis, they should have met with no success? Thus it is that we are apt to err, when, depending too much on our own reason and imaginations, we sit down contentedly in our studies, and feed ourselves with our own weak fancies, instead of looking for truth into the magnificent works of the Creator, though such inspection alone can give us just notions of what we desire to know."

On examining a chrysalis we are enabled to discover, encased in separate parts, the eyes of the future butterfly, as well as its wings, of a small size, folded upon the sides; whilst arising from the head, and laying along the breast, are to be observed several slender divisions, which on being carefully examined, are easily discovered to be the two filaments of the proboscis or tongue, the coverings of the legs and of the antennæ, which are the outermost pair, and are distinctly articulated along their whole length, and are thickened towards the tip; the joints of the abdomen are all plainly marked by various indentations, but the lower legs and wings are not very plainly visible, being concealed beneath the preceding pairs of those organs.

When the insect has remained under the form of a pupa for a sufficient length of time to bring all the various enclosed organs to a proper state of consistence, the period of bursting the walls of its prison may often be easily ascertained; the golden colour with which it had been adorned becomes indistinct, and in those chrysalides which have the skin of a sufficient thinness, the colours of the wings of the enclosed butterfly may be distinctly perceived. The extremities of the legs are now observed to move very plainly, and at length this motion is so much increased, and the wings are so enlarged, that it is no longer possible for the dry and brittle skin which covers the whole to withstand the movements and dilatations of the enveloped butterfly; it accordingly gives way in a longitudinal slit down the middle of the back, where there is usually a suture for this purpose. This slit rapidly extends along the head, and then down the breast on each side of the cases of the antennæ, so that the skin of the chrysalis is burst into four distinct and regular formed pieces, one of which had previously enclosed the antennæ, legs, &c., another the abdomen, and the remaining two the two pairs of wings. The butterfly now makes its escape out of this rupture—its wings soon assume their full size, the insect emits a quantity of reddish coloured liquid, which has been regarded by the superstitious as bloody rain, and in a short time it is enabled to join its companions in the air.

> "Where he arriving round about doth fly
> From bed to bed, from one to other border;
> And takes survey, with curious busy eye,
> Of every flower and herb there set in order.
> Now this, now that, he tasteth tenderly,
> Yet none of them he rudely doth disorder;
> Ne with his feet their silken leaves deface,
> But pastures on the pleasures of each place."
>
> Spenser.

Some groups of butterflies are remarkable in their perfect state for the very small and undeveloped state of their fore legs, and it is a curious circumstance that this should occur in those species which we have already seen to be distinguished by their powerful flight and splendour of colouring, namely, in the family *Nymphalidæ*. There is another circumstance of considerable singularity connected with this subject, and which appears not easily reconcilable with our ideas of the instincts of animals, viz. that those butterflies, which in the perfect state are furnished with six perfect legs, attach themselves, on assuming the pupa state, in such a position that, on arriving at the perfect state, they will have occasion only to burst their fetters and creep at once along the surface upon which they have been affixed, whilst those butterflies which have the fore legs rudimental and apparently incapable of rendering any assistance, suspend themselves vertically in the manner above described, so that they must necessarily come into the perfect state head downwards, and have to ascend the outside of the fragile pupa case with the assistance only of their four hind legs, before they can obtain a sure footing on the twig or leaf from which they have been suspended.

It has been well said that the life of the perfect butterfly affords but few materials for the historian; however pleasant to contemplate, it is barren of facts. The historian, both of butterflies and men, must not look to peace and pleasure for the most abundant interest in his subject.

The mode of flight in these diurnal lepidoptera varies as considerably as in birds, and affords to the experienced entomologist a surprising number of shades in which the distinction of species may even be traced. The collector knows at a distance the flight of the different genera, and even occasionally that of the different species. But unfortunately the knowledge of these differences in the modes of flight is the fruit of long experience, and can scarcely be imparted by simple descriptions; in fact, it is necessary to employ comparative terms for the purpose, which, except to the experienced collector, can scarcely be considered as intelligible.

M. Lacordaire has published the most complete memoir upon this subject in the Annales of the French Entomological Society; but his paper is exclusively confined to the butterflies of South America.

We must reserve for a future occasion various peculiarities relative to the physiology of these insects in their different states, as well as their systematic distribution.

In like manner we have reserved our pictorial illustrations of these insects for our two plates of butterflies. In the first we have represented several splendid exotic species, as *Papilio Turnus* from North America, *Papilio Ægeus*, and *Sarpedon* from New Holland, *Cynthia Orythia*, var. from China, and *Thecla Sugriva*, (Horsf.) from Java. Our second plate consists of rare British butterflies, as *Papilio Machaon* and *Podalirius*, the purple edged copper (*Lycæna Chryseis*), and the *Polyommatus Arion* and *Artaxerxes*—together also with the caterpillars of the swallow-tail and nettle butterflies in the act of commencing their transformations, and the chrysalis of the latter, at the moment before attaching itself to the silken button.

BUTTERFLY-PLANT is the *Oncidium* (tubercles on lip) *papilio* of Lindley. It is one of the *Orchis* tribe, and a native of Trinidad. Like many of the same family, it is of very curious structure, and in shape quite grotesque.

BUTTER-NUT is the fruit of the *Caryocar nuciferum* of Linnæus. A large tree indigenous to Brazil. The flowers are polyandrious, and the tree belongs to the order *Rhizoboleæ.*

BUTTON-FLOWER is the *Gomphia* (a club) of Schreber. A genus of evergreen shrubs, natives of Jamaica. They are decandrious, and belong to the order *Ochnaceæ.* They bear long spikes of brilliant yellow flowers, and neat serrated shining leaves.

BUTTON-TREE is the *Conocarpus* (cone fruit) of Jacquin. It is a pentandrious plant, and belongs to the natural order *Combretaceæ.* They are natives of the West Indies, and said to be highly ornamental.

BUZZARD (*Bute*). One of the genera, or perhaps rather sub-genera, into which the great genus *Falco*, or diurnal birds of prey, are sometimes divided, and

Buzzard.

which includes a number of species, some of which differ considerably in the minutiæ of their characters. In general they have the wings long, but there are differences in that respect, and some are known par-

Moor Buzzard.

ticularly by the name of long-winged hawks, and others by that of short-winged hawks. Their feet are sometimes feathered down to the toes, and sometimes not; indeed, the only character in which they all agree is that of having the beak hooked from the base. We shall be better able to show the manners of the leading species, as well as their differences from each other, in one general article, HAWK, than

Honey Buzzard.

in detached notices of the genera, the arrangement of which is far from being satisfactory. To that article we shall therefore refer for notices of all the diurnal birds of prey, with the exception of the *Vultures*, *Eagles*, and *Kites*.

BYRRHIDÆ (Leach). A family of coleopterous insects belonging to the section *Pentamera* and to the division *Clavicornes* of Latreille, or those beetles which have the antennæ terminated by a club-shaped mass. The legs are more or less compressed, and capable of being so closely applied to the body that they are not all perceivable when the insect is alarmed; hence, and from the rounded form of these insects, they have obtained the name of pill beetles. This group appears to be intermediate between the families *Dermestidæ* (bacon beetles, &c.), and that of the mimic beetles, *Histeridæ;* from the preceding it differs in having the legs perfectly contractile, the tarsi folding upon the tibiæ, the latter upon the femora, and the whole being then lodged in grooves formed for their reception on the under side of the body; whilst it is distinguished from the mimic beetles by the antennæ not being elbowed at the extremity of the first joint, and by the jaws not being exposed.

These insects are of small size and of obscure colours; their numbers are likewise not very extensive, but there is considerable difference in their economy, some, in the perfect state, being found in sand-pits and under stones, in fields, roads, &c.; whilst others frequent flowers, as the perfect anthreni, or are observed beneath the bark of trees, or upon the coast.

The genera are *Byrrhus*, Linnæus; *Simplocaria, Oomorphus, Syncalypta, Nosodendron, Aspidiphorus, Trinodes* and *Anthrenus*, all of which are natives of England.

The first of these genera, *Byrrhus*, is distinguished by the club of the antennæ being distinctly five-jointed, by the palpi being terminated by a somewhat hatchet-shaped joint, and by the prosternum being dilated in front, covering the under side of the mouth. These insects possess in the highest degree the power of counterfeiting death by the contraction of their legs. They are likewise the largest individuals in the family, although their length seldom exceeds one third of an inch. There are nine or ten British species, of which the *Byrrhus pilula* of Linnæus is the type, as well as one of the most common species.

The genus *Nosodendron* (Latreille) is distinguished by its oval shape, large exposed mentum, and antennæ terminated by a large three-jointed club; the elytra are moreover adorned with little bundles of hair. The only British species, *Nosodendron fasciculare* (Fabricius), is found in elm trees, having been taken by the Rev. F. W. Hope, at Southend, under the bark of some of these trees which were placed in the sand to arrest the incursions of the tide.

With the exception of *Anthrenus* (Geoffroy), the other genera do not present any material characters worthy of notice in a work like the present. The genus last mentioned is, however, more deserving of attention, both from the ravages which its larvæ commit upon preserved animal substances, objects of natural history, &c., and from the curious formation of the larvæ themselves. Perhaps there is nothing more curious amongst insects than that, during the preparatory states of an animal, its habits should be totally distinct from those of its adult state. The perfect Anthreni are generally found on flowers, preferring, as we have often observed, those of umbelliferous plants. They employ their wings, seeking after impregnation, to penetrate every spot where dried and preserved animal remains are to be found, in order to deposit their eggs in such situations. They counterfeit death, also, like the Byrrhi, and, from their small size and banded colouring, look like small seeds. In the larvæ state they are exceedingly destructive, especially in museums, whence they have obtained the name of museum beetles, devouring the internal parts of bird skins, preserved insects, &c., and attacking feathers and hairs, reducing all to powder. They must not, however, be confounded with the *Tineæ*, or small fleshy grubs found in similar situations, which form for themselves cases of hair, woollen, &c. The larvæ of the anthreni, on the contrary, are uncovered except by their own coating of hairs, which are disposed in bundles, the posterior part of the body being furnished with two large patches, which are longer than the first, and each of which is thickened in a singular manner at the tip, These crests, as they may be termed, are so arranged that the insect has the power of spreading them out, in which position it affords a very beautiful object when magnified.

The perfect insects are of a rounded and depressed form, the surface of the body being adorned with undulated bands of coloured scales, which are easily rubbed off; the antennæ are terminated by a three-jointed club, and are capable of being retracted and concealed in grooves on the under side of the thorax, which is produced behind, on its upper side, into three lobes. There are five or six British species, of which the *Anthrenus* (Byrrh.) *Musæorum* of Linnæus is the type, and which seldom exceeds one-eighth of an inch in length.

BYRSONIMA (Richard). So named from byrsa, a hide; for tanning which the bark is useful. There are thirteen species, all tropical trees and shrubs. They belong to *Decandria Trigynia*, and to the natural order *Malpighiaceæ*. The greater number of the species were heretofore ranked in the genus *Malpighia*.

BYSSOMIA (Cuvier; Saxicava, Lamarck). This genus, which Cuvier considered perfectly distinct from the genus *Saxicava* with regard to the animal, differs but little as respects the shell, which closely approximates to the genus *Saxicava*, of which Lamarck makes it a species: it inhabits rocky fissures, with the muscles and other shells attached by a byssus; but it is sometimes found buried in the sand, small stones, and the roots of fuci, and even in the polymorphous *Millepora*, in which cases according to the observations of Fabricius, it is divested of byssus. The animal has its body more or less elongated, subcylindrical, and prolonged backward by a tube bifurcated only at its extremity, there being an opening at the lower and anterior part of the mantle, for the passage of a small channelled foot, and for the byssus, situated at the posterior base, and it has two powerful adductor muscles.

The shell is bivalve, often irregular, with a strong epidermis, oblong, coarsely striated lengthwise, equivalve very inequilateral, obtuse, larger in front, and as if rostrated at the back part; the summits but slightly marked, hinge without a tooth, or with only the rudiment of one; beneath the corslet a rather long exterior ligament, and two distant rounded muscular impressions. Only one species is known, the *Byssomya pholadis*, mentioned by Muller in his Danish Zoology.

BYSSUS. Several species of acephalous, or headless molluscs, produce an extremely fine kind of silky filament, commonly called the beard; it is similar to that of insects, and employed by the animal to attach itself to rocks or other objects, in such places as it inhabits. It is formed by a conglomerate gland placed near the foot, which latter part draws out the silk from the excretory duct, and moulds it in a groove on its surface. The muscle, perna, pinna, and some other genera of molluscs, produce a byssus; the latter in such abundance that it is found in tufts several inches long: in texture it closely resembles raw spun silk, it is of a pale brown colour, and capable of being manufactured into articles of dress, such as stockings and gloves, more however as objects of curiosity than articles of commerce: of these, specimens are to be seen in the British, and other museums. The configuration of many molluscs not known to spin a byssus, appears to indicate its existence, and their local dwelling tends to confirm that opinion; but the impossibility of becoming intimate with creatures we cannot study in their native element, while they are in the full exercise of their functions, renders it difficult in many cases for naturalists to reason beyond analogy; the best guide perhaps that can be taken, though not always a safe one to build a system upon, as the sports and freaks of nature are so extraordinary, that they baffle the best endeavours to reconcile them to our understanding.

That colossus of bivalves, the *Tridacna gigas* of Lamarck, *Chama gigas* of Linnæus, is said to affix itself to rocks by a bundle of tendinous fibres, or byssus, by which it remains suspended, notwithstanding the magnitude of these shells, which sometimes attain the weight of 600 pounds, and measure several feet in length: this assertion, and that of the force with which the valves are closed, being able to snap a ship's cable asunder, like many of the strange sights travellers see, want additional confirmation to be here given as established facts, though, reasoning by analogy, no doubt might exist of the one or the other.

A modern author, speaking of the byssus spun by the common muscle, *Mytilus edulis*, asserts that the animal, when it has commenced "spinning its cable, will make a trial of its strength by drawing it strongly towards her, before she proceeds to stretch out a second, and these cords, which she spins with so much art, are in reality as serviceable to them as cables are to a ship." He adds, that there are "frequently 150 of those little cables employed in mooring a muscle, each cable scarcely two inches long."

The writer of this article has patiently observed the habits of muscles for days together, in situations favourable to their growth, and never could witness the animal in the act of spinning its miniature cables, much less observe that spider-like kind of wisdom, of trying their strength when produced. He made numberless experiments to enable him to do so, all ending in the fact, that these animals *do* moor themselves to various submarine bodies by their silken threads, under peculiar circumstances of situation, often in groups suspended to each other, generally in beds or strata, and sometimes, but very rarely, single individuals were seen attached to stones or other matter, not moveable by the action of the tide; but when or how this operation was effected, the writer never could ascertain, from the most minute ocular examination. With regard to the length of the threads, they varied from one-tenth to two inches and a half, but they never appear disposed with any appearance of regularity or order, as to *purpose*, beyond that of meeting with any object in its vicinity. The numbers of these threads frequently exceeded one hundred, and when all but a few were separated or removed from the mollusk, no attempt was made to renew them in the same or any other direction; but when a number of individuals were carefully wiped, and freed entirely from every appearance of byssus, they all shortly spun threads attached to the nearest object, whether each other or not, indicating a consciousness of their utility, without exhibiting any other of those instinctive habits, more peculiarly observable in some of the spinning animals, and another proof, were it requisite, of the difficulty of ascertaining where instinct ends, or reason commences.

The fine linen called, in Greek, byssus, mentioned in sacred writing, of which the costly sacerdotal garments were made, is supposed by some commentators to have been fabricated from the silken produce of the pinna; but as its brilliant white hue is so highly praised, it was more probably made from asbestos, the art of weaving which was well known to the ancients, and cloth of it was used to preserve the ashes of princes and heroes from becoming mingled with the more ignoble dust of the woods and rare spices whose aromatic flames consumed their mortal remains.

BYSTROPOGON (Le Heritier). The name signifies close throated, as applied to the tube of the flower. It is a genus comprising four species of green-house under-shrubs, natives of the Canary Islands. They belong to the natural order *Labiatæ*, and are plants of no great beauty.

BYTTNERIA (Loeffling). A genus of shrubs, under-shrubs, and herbs, natives of many of the warmer parts of the world. They bear pentandrious flowers, and give name to an order of the natural system, viz. *Byttneriaceæ*. The generic character, according to Loeffling, is—calyx five-parted; petals clawed, cupped at top, or eared, ligulated at the back; tube pitcher-shaped, bearing the stamens, having from five to ten teeth; anthers twinned, seated on the top of the tube; styles short; stigma five-cleft; capsule five-berried, somewhat prickly, in each berry one seed.

BYTTNERIACEÆ, or BÜTTNERIACEÆ. A natural order of dicotyledonous plants containing thirty-five genera, and upwards of two hundred species. It sometimes receives the name of *Sterculiaceæ*, or *Hermanniaceæ*. It is nearly allied to the *Malvaceæ*, *Tiliaceæ*, and *Elæocarpeæ*. From the first of these orders it is distinguished by its two-celled anthers, and from the two last by its stamens being united into one bundle by their filaments.

Its essential characters are, calyx consisting of five divisions or sepals, more or less united at the base with a valvate æstivation, sometimes furnished with bracteæ; petals five, alternate with the sepals; stamens five or indefinite, monadelphous; anthers two-celled, opening behind; pistil consisting of five, rarely three carpels, distinct or combined into one ovary; styles equal in number to the capsules; seeds often winged.

The plants included in this order are exotic trees or shrubs with alternate leaves, and a starlike pubescence, and are propagated by cuttings and seeds.

The order is divided into several sections.

I. The true *Byttneriaceæ*, including the genera *Byttneria*, *Theobroma*, *Abroma*, *Guazuma*, *Commersonia*, *Glossostemon*, *Ayenia*, and *Kleinhovia*, natives of South America the East and West Indies, and New Holland.

II. The *Sterculiaceæ*, comprehending the genera *Sterculia*, *Heritiera*, *Triphaca*, and *Reevesia*, found chiefly in Africa and India.

III. *Lasiopetaleæ*, including *Lasiopetalum*, *Leringia*, *Guichenotia*, *Thomasia*, and *Keraudrenia*, which are solely New Holland genera.

IV. *Hermanniaceæ*, comprehending *Hermannia*, *Melochia*, *Mahernia*, *Waltheria*, *Altheria*, and *Riedleia*, genera chiefly found native at the Cape of Good Hope.

V. *Dombeyaceæ*, to which belong the genera *Dombeya*, *Pentapetes*, *Astrapæa*, *Ruizia*, *Assonia*, *Melhania*, *Trochetia*, *Pterospermum*, *Kydia*, and *Gluta*, natives of Africa and the East Indies.

VI. *Wallichieæ*, including the genera *Wallichia*, *Eriolæna*, and *Gœthea*, which are found native in India and South America.

The general properties of the order are mucilaginous and emollient, and it contains some plants which are highly important in an economical point of view.

One of the most important genera is *Theobroma*, a name derived from two Greek words signifying "the food of the gods." *Theobroma cacao*, smooth-leaved chocolate tree, is found native in South America, and grows in abundance on the banks of rivers in that country. It is also cultivated extensively in the West Indies. It is a tree about the size of a middling apple-tree, attaining a height of fifteen or sixteen feet, with bright green leaves, and small reddish inodorous flowers. Its fruit is about three inches in diameter, and has some resemblance to a cucumber. It is smooth, of a yellow or red colour, and is furnished with a fleshy rind nearly half an inch thick, which encloses a whitish pulp of a buttery consistence. The pulp separates from the rind when ripe, adhering to it only by a few filaments. Hence the seeds are ascertained to be ripe by the rattling of the seed-vessel. The pulp has a sweetish, slightly acid taste, and is eaten by the natives of America. The tree has a very beautiful appearance when laden with ripe fruit. The seeds, after being separated from the pulp and dried in the air, are sold under the name of cacao beans or nuts. They must not be confounded with cocoa-nuts, which are the produce of a totally different tree. Cacao-beans resemble almonds in shape, and, when fresh, have a flesh-colour and a sharp bitter taste. They were formerly used as money in America. Each capsule contains about twenty-five seeds, and a cacao-tree yields three or four pounds of beans annually. The unripe seeds are sometimes eaten when preserved in sugar.

From the kernel of the cacao-tree the well known paste called chocolate is prepared. This has been used from time immemorial by the Indians, and was first introduced into Europe by the Spaniards from their American colonies. The French did not cultivate the tree in their colonies till the middle of the seventeenth century. Large cacao plantations now exist in America and the West Indies, whence the beans are exported in considerable quantities. These plantations are generally formed near the banks of rivers, in order that a copious supply of water may be procured in dry seasons. The trees are generally planted in straight lines, about fifteen or sixteen feet asunder, and they are screened as much as possible from the direct rays of the sun by plantains and other large trees. They thrive best in a moist atmosphere and cloudy sky, and under a mean temperature not below 73° of Fahrenheit. The trees do not acquire their full vigour for seven or eight years, and they are very apt to be attacked by insects and parasitic plants. Two crops are gathered from them in the year, one in June and another in December. The kernels, after being freed from the shells and well dried, so as to prevent them from becoming mouldy, form the basis of chocolate, which is prepared in the following way. The kernels are first roasted at the fire in an iron pan full of holes, they are then pounded in a mortar and freed from any impurities, afterwards they are ground on a warm marble slab and made into a sort of oily paste, sugar being at the same time added in greater or less quantity. This paste is then mixed with vanilla and various spices, such as canella and cinnamon, in order to make it easy of digestion, and some colouring matter, as arnotto, is added. It is then put into polished iron moulds and made into cakes or rolls, which must be kept in a box perfectly dry. In France, chocolate is manufactured in various forms, and a stranger is not a little astonished at the curious figures made of chocolate, which are exhibited in the shops in Paris. When chocolate is prepared plain, without any spices, it is called, in France, *Chocolat de Santé*. Chocolate as manufactured by Spaniards, besides cacao, sugar, and vanilla, sometimes contains pepper, cloves, cinnamon, anise, achiotte, and even musk and ambergris. The Italians and Spaniards roast the cacao-beans much more than the French, so as to give them a darker colour and a more bitter taste. Chocolate is not imported into this country, and hence what is consumed in Britain is manufactured in the country from the cacao-beans, which are imported from the West Indies and the Caraccas. It is said that Castile soap is often added to British chocolate in order to make it froth when dissolved in hot water. The chocolate made in this country pays a fixed duty. Families are allowed to make their own chocolate provided three days' notice is given, and a quantity of the nuts, not less than half a hundred weight, is used at once. Spanish chocolate has more oil in it than that which is manufactured in Britain. Chocolate is a favourite beverage with the Spaniards, and is also much used in Jamaica. It is used either in a crude state, or boiled in water or milk. When good it ought to be entirely dissolved, leaving no sediment. It is best when newly prepared.

Chocolate has been recommended medicinally as a nutritious article of diet, and a good tonic. It has been found serviceable in hypochondriasis, and in cases of debility and emaciation. In the case of patients labouring under consumption and other lingering diseases, the use of chocolate has been attended with very beneficial results. It is sometimes given to disguise the taste of drugs such as quinine. When fresh ground and cooled in tin vessels, chocolate becomes highly electrical, but loses this property by being dried or powdered.

Cacao contains a great quantity of a thick whitish solid oil, which is separated by boiling water, and is commonly called *Butter of Cacao*. It is used as a cosmetic on account of its agreeable odour, and the rapidity with which it dries. It is also used medicinally as an emollient soothing application to sores.

The shell of the cacao-bean is sometimes employed as a tonic.

Cocoa is an oily and slightly bitter preparation, made in Britain from the seeds of the cacao tree. It is very nourishing, and is perhaps more easily digested than chocolate.

The seeds of *Theobroma Guianensis*, another species of the genus, are eaten in a fresh state.

Guazuma ulmifolia is a wide spreading tree like an elm, the fruit of which abounds in a sweetish mucilage. In Jamaica the leaves are somtimes used as food for cattle. The bark is employed as a sudorific, and an extract from it is used in Martinique to clarify sugar. The wood is light, and is used by coachmakers. *Glossostemon bruguieri* is interesting as being the only plant in the order which is found native in Persia.

Sterculia is an extensive genus of the order, consisting of fine umbrageous trees, the fruit of which is a good illustration of what is denominated by botanists a *follicle*. The seeds are in general large and eatable, and are filled with an oily fluid which can be expressed for use. *Sterculia urens* is a large tree, found native in the mountainous countries on the Coromandel coast. It has a soft spongy wood which the Hindoos use in the manufacture of guitars. The bark is very astringent and tinges the saliva of a reddish colour. The seeds are roasted and eaten by the natives. *Sterculia tragacantha* furnishes the gum tragacanth of Sierra Leone. The seed of *Sterculia acuminata* is the famous *Cola nut* of Guinea, mentioned by African travellers, which has the property, when chewed, of rendering bad water pleasant and agreeable. A decoction of the fruit of *Sterculia fœtida* is mucilaginous and astringent. The pods are used in Java in the cure of gonorrhœa. The seeds are oily, and are said to cause sickness and giddiness. The seeds or nuts of *Sterculia chica* are highly esteemed in Brazil as an article of food.

Waltheria douradinha abounds in mucilage, and is considered by the Brazilians a remedy for syphilis. The genus *Astrapœa* furnishes some of the most beautiful plants in the world.

From these details it will be seen, that this interesting family occupies an important place in the vegetable world, whether we regard it as furnishing nutritious articles of diet, or supplying the means of curing disease.

CAAPEBA. The name of a species of the genus *Cissampelos;* the root of which is used medicinally in South America, as a mucilaginous diuretic.

CABBAGE is the *Brassica oleracea* of botanists. Linnæan class, *Tetradynamia ;* natural order, *Cruciferæ.* Generic character : calyx erect and closed ; seed-vessel long, round, opening by two valves, and having a central dissepiment; style short, obtuse, seeds in one row ; cotyledons folded together.

This very useful culinary plant is a native of Britain, and found among the rocks on the sea shore. In its wild state it has comparatively small gashed leaves, and runs up to flower without any central turning in of the leaves. But small and unsubstantial as the leaves are, they are found to be wholesome, and particularly antiscorbutic ; and in all probability have in the course of time been raised from an article of medicine to a principal one of diet.

No plant shows the effects or repays the labour of cultivation more the cabbage; nor has any one sported into more useful varieties. There are above twenty different varieties and sub-varieties cultivated; and if all its alliances were included, double this number might be named.

The cabbage is particularly well adapted to the climate of this country, and in the same latitudes on the continent. In more southern latitudes they do not arrive at much perfection, owing to the higher temperature forcing them to flower before the heart is sufficiently formed.

The cabbage may be used in every stage of the growth ; when young they are the most delicate and sweetest of greens : and when the principal head is cut, the stems produce an acceptable supply of sprouts. The plant is variously useful; the smaller varieties are cultivated in gardens for kitchen purposes ; the red for pickling, and the large drumhead sort are grown in fields for cattle. Many of the large sorts are also manufactured into sour kraut, an indispensible condiment in Germany, and highly useful to the crews of ships on long voyages. For general usefulness it is next to corn and the potato; and over the last it has the advantage of being proof against the hardest frosts.

The cabbage, as well as most of its varieties, are biennials, that is, the plants require parts of two years to bring them to their seeding age. But as it is their leaves and not the seeds which is the object of the cultivator, he bestows such management as will bring the plants successionally into use, and so that they may be had for table every day in the year.

All the different sorts require strong and rich loamy land; they are what are called "gross feeders;" but their flavour when cooked is mild or rank, according as the soil is more or less rich. On a light sandy soil, the cabbage, though small, are sweeter flavoured than if grown on heavy highly manured land. Quantity is required in some cases, as for market or for cattle, for instance, while quality is the aim in other cases. For each purpose there are practical rules which are acted on accordingly.

The spring crop of cabbage, that is, such as come into use in the month of May, are most esteemed, and require more management than any of the following crops. The seed for this first crop should be sown on an open-lying spot some time between the 25th of July and the 5th day of August; or a better plan is to sow on both these days for security of having them as early, and as free from the risk of the plants running away to flower as possible. If the seed were sown on the 20th of July, nine out of every ten of the seedlings would probably run to seed in the spring instead of heading: and if sown after the 5th of August the crop would not come in so early as they otherwise would do. Therefore, any day between the 25th and the end of July is the best time for the latitude of London.

When the seedlings appear they must be kept free from weeds, and occasionally watered if the season be dry; and as soon as they have got four or five leaves, they should be carefully drawn and pricked out four inches apart on a rich well-prepared nursery bed to induce a stocky growth, and where they should remain till about the middle of October, when they should be planted out for good.

An open quarter should be chosen for cabbage, liberally dunged, and well digged. On this the plants from the nursery bed are put out in rows at distances according to the size of the kind. The early dwarf and York varieties are placed in rows eighteen inches asunder, and twelve or fourteen inches between plant and plant. The middle sized sorts, as the sugar-loaf and Battersea, may be put in rows two feet apart and sixteen inches asunder in the rows. The largest growers, as the drumhead, require three feet intervals between the rows, and two feet spaces between plant and plant.

It is usual to draw drills, or tread furrows for the plants to be dibbed into, letting them in as deep as the leaves, and pressing the earth firmly to the roots. The after management consists in keeping the surface loose and clean by the hoe, filling up blanks, and, when the plants require it, drawing earth to the stems to keep them steady and encourage the growth.

In April the plants will have gained a good size and will be beginning to head; this will be assisted by tying up the outer leaves round the centre with strands of matting, to blanch the heart.

Succession crops of summer cabbage are raised on seed beds sowed in March, April and May. These supply plants for putting out in May, June and July, which, with those drawn from autumn sowings, furnish a constant supply of either headed or open cabbage throughout the year.

Open plants or coleworts are preferred by many to close-headed or white cabbage. They are sweeter in flavour, and the green colour is inviting. Coleworts may be had at any time in the year; but for winter and spring use, seed-beds should be sowed in June, and again in July, to raise plants of any of the middle-sized varieties, viz., sugar-loaf, or early Battersea. These seedlings may be planted out on any vacant piece of ground during August and September, pretty thickly together, say nine inches apart every way, and thus to stand till pulled for use.

The enemies of the cabbage are the finches, which devour the seedlings, if not scared off; the turnip-fly in the spring, and slugs and snails all the year. The two last may be kept off by dusting the seed-beds and transplanted rows of plants with fresh slaked lime. For this purpose, a thin canvass bag, large enough to hold about half a peck, when full, is most convenient. This, held by the mouth, and charged with two or three pints of lime, jerked over the beds or plants, drives every fly, slug, or worm, from the place, and being repeated occasionally, especially after rain, will effectually defend the plants. The caterpillars of several butterflies live on the outer leaves all summer, but no preventive has yet been found for this injury. But the worst enemy is an insect called *Nedyus contractus*, which inserts its eggs in the stem under the surface of the ground, which soon become maggots, produce deformity, by raising large knobs over each of themselves—hence called "clubbing," or "fingers and toes,"—and sometimes in such numbers as always to weaken, if not destroy, the plant. At the transplanting season, if any such knobs appear on the root or stem, they should be pared off, and the roots dipped in a puddle of earth and soot before planting, to prevent future attacks. A dressing of marl, or soap-boilers' waste, is said to prevent clubbing; and, on the same principle, were the seed-beds watered with soap-suds once or twice during the growth of the seedlings, there is no doubt that it would go far to prevent the attack of the insects, the alkaline principle, it would seem, being offensive to them.

The large sorts of cabbage for cattle are generally sowed in the first week in August, and planted in the fields either in the autumn or spring, most commonly in the latter season. In the following autumn they come into use.

The red varieties have always a place in gardens. There are three sorts, viz., the common Dutch, the small red, and the Aberdeen red. The seed should be sown in August for the next summer supply; and again in March, to come in the autumn and winter. Red cabbage require wider intervals than the common sorts, and are usually planted in single rows between the beds of other dwarf-growing crops. The heads are chiefly used for pickling, or shredded in salads. They are also sometimes cultivated in fields for winter-keep for sheep, being much hardier than the white varieties.

The following are the varieties in cultivation:—

1. Early Emperor.
2. —— Dwarf.
3. Fine Screw.
4. Wellington.
5. Early York.
6. Large York.
7. Early Heart-shaped.
8. London Battersea.
9. East Ham.
10. London Hollow.
11. Early Sugar-loaf.
12. Early Flat Battersea.
13. Late ditto ditto.
14. Early Imperial.

15. Paington.
16. Drumhead, or Scotch
17. Fine Red Globe.
18. Thousand Headed.
19. Dwarf Drumhead.
20 Braganza, or Choux-trouchad.
21. Turnip-rooted above ground.
22. Ditto under ditto.
23. Green and Purple Kohl Rabi.

Of the above the most suitable for private gardens are numbers 1, 2, 5, 6, 8, and 11; for cottagers, 5, 6, 8, and 11; and for agricultural purposes, numbers 16, 17, 19, 21, 22, and 23. The other culinary articles belonging to the cabbage family, as Cauliflower, Broccoli, &c., are described under their proper names.

CABBAGE TREE is a West Indian palm, the *Areca oleracea* of botanists. Linnæan class and order, *Monœcia Monadelphia;* natural order, *Palmæ.* Generic character: flowers sitting on the same spadix, upper ones male, lower ones female; calyx three-parted; corolla of three petals; stigmas sitting; berry or drupe fibrous, one-seeded. Specific character: fronds pinnated; leaflets linear acute; fruit oblong. This species of palm is called the cabbage tree, not so much from its appearance as from the use the inhabitants put it to. The leaves are crowded together at the top of the stem, and when these are cut off, the central ones are found to be white and tender, and which, when boiled, are used as a substitute for cabbage—hence the name.

CACALIA (Linnæus). A genus of mostly succulent plants, of very grotesque form and habit. Linnæan class and order, *Syngenesia Æqualis;* natural order, *Compositæ.* Generic character: anthodium cylindrical, of many parts, scaly at the base; receptacle naked; pappus hairy, rough. The succulent species are of the same nature, and require the same treatment, as mesembryanthemums. The *C. kleinia* is called the cabbage-tree from the green gouty resemblance of the stalks to those of cabbage. In some countries the leaves of some of the species are used as salad, and the stalks are used as pickles.

CACHRYS (Linnæus). A genus of herbaceous perennial plants, chiefly natives of Europe. Linnæan class and order, *Pentandria Digynia;* natural order, *Umbelliferæ.* Generic character: involucre none; calyx none; corolla petals ovate, lanceolate, acute; seed oblong, rounded, smooth, and fungous. These plants have carminative qualities, approaching those of rosemary, on which account the latter-named plant was called cachrys by the Romans.

CACTEÆ. Indian fig family. A natural order of dicotyledonous plants, containing nine genera, and upwards of one hundred and fifty species. It is nearly allied in its characters to the *Grossularieæ*, or currant tribe, from which, however, it is completely different in habit. This order sometimes receives the names *Opuntiaceæ, Nopaleæ*, and *Cactoideæ.* It has been divided into two sections, *Opuntiaceæ*, in which the ovula and seeds are fixed to the parietes of the fruit, and *Rhipsalideæ*, in which they are attached to a central axis. The former includes the genera *Cactus, Melocactus, Opuntia, Cereus, Mammillaria, Echinocactus, Epiphyllum*, and *Pereskia*, while the latter contains the single genus *Rhipsalis.*

The essential characters of the order are,—sepals numerous, usually indefinite, gradually passing into petals, either crowning the ovary or covering its surface; petals numerous, arising from the mouth of the calyx, often more or less combined; stamens numerous, in many rows, more or less cohering with the petals and sepals; filaments long and slender; anthers ovate; ovary fleshy, one-celled; style filiform; stigmas many and clustered; fruit, a fleshy berry, smooth or scaly, or tuberculated; seeds enveloped in pulp, without albumen.

The plants belonging to this order are perennial succulent shrubs, presenting very various and singular forms. Some have angular tall stems, while others have rounded spiny ones, not above a few inches high. In general the stems and branches are jointed. The leaves are either very minute, or are altogether wanting, their place being supplied by spines. The flowers are generally white, scarlet or purple, and in some instances are showy and magnificent, frequently ephemeral. The fruit is sometimes small, at other times large, and resembling a fig in shape. From this circumstance the English name of the family is derived. From being succulent, and possessing few evaporating pores, the cacteæ are remarkably well adapted for hot, dry and exposed places. They inhabit the arid soils of the warmest parts of America, whence they have been transported to the rocks of Asia, and the burning sands of Africa. They extend only a short distance beyond the tropics on either side; their northern limit is said to be 33° or 34° north latitude.

The fruit of many plants of the order is esculent. It has sometimes an agreeable acid taste, and at other times is very insipid. Some of the plants yield an acrid milky juice.

The cacteæ is propagated by cuttings, offsets and seeds, and thrive best in dry sandy loam, or in loam mixed with a little brick rubbish.

One of the most important plants of the order is the *Cactus cochinellifer*, or *Opuntia coccifera*, the spineless cochineal fig. This is a large shrub nine feet high, bearing red edible berries, which are said to possess diuretic properties. It is cultivated extensively in the West India islands as food for the cochineal. The plantations of this cactus are called in Mexico *Nopaleries*, from the Indian name of the plant. The cochineal (*Coccus cacti* of Linnæus) is a homopterous insect, not unlike the mealbug of our gardens. The male insect is winged; the female alone is used as a dye. There are two kinds of cochineal, which are reputed to feed on different species of cacti. One of these, the wild or common cochineal, is covered with a silky envelop, and is not so valuable as the fine or cultivated cochineal, which has a powdery or mealy covering. The female insects, after feeding on the cacti for three or four months, are brushed off by means of a squirrel's or deer's tail, and are then killed by exposure either to the sun or to the vapour of hot water. When dried they are exported in large quantities for the purpose of furnishing a rich scarlet dye. The colouring matter is extracted easily by water, alcohol, or hartshorn. It is stated that 800,000 pounds of cochineal are annually brought to Europe; each pound containing about 70,000 insects. The annual consumption in Great Britain alone is estimated at 150,000 pounds, worth 275,000*l.* sterling, a vast amount, as has been observed, for so small a creature, and well calculated to show us the absurdity of despising any animal on account of its minuteness. Cochineal possesses stimulating properties. It was formerly used as an anodyne in hooping-cough, but is now employed chiefly for the purpose of colouring tinctures and lip-salves.

Opuntia vulgaris, or *Cactus opuntia*, is found growing abundantly between Rome and Naples. It bears a berry of a deep purple colour. Its prickly leaves abound in a mucilaginous matter, which is used as an emollient poultice in some countries.

Opuntia Tuna is cultivated in Mexico and Brazil as food for the cochineal. It is used for hedges in Spain, South America, and the West Indies. When the island of St. Christopher was to be divided between the British and French, three rows of this plant were planted by common consent between the boundaries. The stamens of this plant possess a peculiar kind of irritability. When a quill or feather is drawn across their filaments, they immediately begin to lie on one side, and then sink down gradually to the bottom of the flower.

Melocactus communis, great melon thistle, or Turk's cap, is like a large fleshy green melon covered with sharp prickles. It may also be said to have some resemblance to a hedgehog. The flowers and fruit grow in clusters around the upper part of the cap. In the West Indies this plant is met with two yards in circumference, and four or five feet high. It grows on the steep sides of rocks in the hottest parts of America along with the *Mammillaria simplex* and *prolifera*. The fruit of all these plants is agreeably acid, and is eaten as a cooling fruit in the West Indies. Cattle are said to eat the succulent parts of these plants in the time of drought.

The *Mammillaria simplex* is remarkable on account of yielding a milky juice, which has a sweetish taste, in place of being acid. The milky juice of the *Cereus grandiflorus*, *flagelliformis*, and other cacti, is used in St. Domingo to inflame and blister the skin, as well as to act as a violent purgative.

Cereus repandus, *lanaginosus*, and *Peruvianus*, as well as *Opuntia Braziliensis*, all yield edible fruit.

The best fruit, however, is furnished by the *Cereus triangularis*, or strawberry pear. It is much esteemed in Martinique and other West Indian islands.

Cereus speciosissimus, on account of its beautiful large pink flowers, is extensively cultivated in greenhouses. It is, however, inferior in beauty to the *Cereus grandiflorus*, or night-flowering creeping cereus. This species bears magnificent sweet-scented flowers, which only remain out for about six hours. There is seldom more than one flower expanded at a time. The flower-bud begins to open at seven or eight o'clock in the evening, is fully blown by eleven, and by three or four in the morning is faded and withered. When once the flower closes, it never opens again. The calyx is often a foot in diameter. Its inside is of a bright yellow colour, while the petals are pure white. The plant flowers in July.

The *Cereus flagelliformis* has also fine sweet-scented flowers, which are numerous, of a beautiful pink colour, and remain open for three or four days. The species of the genus *Rhipsalis* are curious jointed prostrate plants.

CACTUS (Linnæus). The melon-thistle, a genus of stove succulents, natives of the driest parts of tropical countries. Linnæan class and order, *Icosandria Monogynia;* natural order, *Cacteæ.* Generic character: calyx bell-shaped, imbricated; corolla, petals six or more inserted on the calyx; stamens numerous, joined to the calyx; filaments awl-shaped; anthers oval, and two-celled; stigma many cleft, berry many seeded. These plants being of remarkable character attracted the notice of travellers in South America, where they are chiefly found, and being tenacious of life, were easily transported to Europe, where some of them have been long cultivated in hot-houses. They are mostly destitute of leaves, and composed of thick fleshy stems entire or jointed, and of the most grotesque shapes. They are spiny; either ranged along the prominent angles of the stem, or growing in tufts on the surface. The Turk's cap (*C. melocactus*) is a regularly formed and curious production; the body being ribbed like a melon, with tufts of short spines along the angles, and bearing its flowers and fruit round the upper part of the tassel of the cap. Full grown plants are sometimes met with in the West Indies two feet in diameter. The interior is a soft green pulp, very full of moisture, and never changing to a woody consistence. The fruit of some of them are eatable, and resemble in shape and size the fig of Europe. This genus, which formerly comprised a great many plants supposed to be species, is now so much divided, that very few real cacti remain.

CADDICE WORMS. The larvæ of the species of insects composing the Linnæan genus *Phryganea*, or the modern order *Trichoptera* (Kirby), are thus named. They are found in the water, under stones, or crawling upon subaquatic plants, and are inclosed in a case of their own construction, the materials of which are very different in the different species. These insects are well known to fishermen as an excellent bait for several kinds of fish. Thus, Izaak Walton tells us, in his chapter on baits, "There be divers kinds of cadis, or case worms, that are to be found in this nation, in several distinct counties, and in several little brooks that relate to bigger rivers;" and he then proceeds to describe several species of them, as first, that which is called a "piper," whose husk or case is a piece of reed about an inch long. "And these be a choice bait for the chub, or chavender, or indeed for any great fish, for it is a large bait;" then there is the "cock spur, being in fashion like the spur of a cock, sharp at one end, and the case or house in which this dwells is made of small husks and gravel and slime, most curiously made of these, even so as to be wondered at, but not to be made by man, no more than a kingfisher's nest can, which is made of little fishes' bones, and have such a geometrical interweaving and connexion, as the like is not to be done by the art of man." Another is called a straw-worm, and by some a fur-coat, "whose house is made of little pieces of bents and rushes, and straws, and water weeds, and I know not what." Derham, in his Physico-Theology, quoted by Sir John Hawkins, states the proceedings of these insects, which he calls cadews: "one sort house themselves in straws, called from thence straw-worms, others in two or more sticks laid parallel to one another, creeping at the bottom of brooks; others with a small bundle of pieces of rushes, duck-weeds, sticks, &c., glued together, wherewith they float on the top, and can row themselves therein about the waters with the help of their feet; both these are called cad-bait. It is a notable architectonic faculty which all the variety of these animals have to gather such bodies as are fittest for their purpose, and then to glue them together, some to be heavier than water, that the animal may remain at bottom where its food is (for which purpose they use stones, together with sticks, rushes, &c.); and some to be lighter than water, to float on the top and gather its food from thence. These little houses look coarse, and show no great artifice outwardly, but are well tunnelled and made within with a hard tough paste, into which the hind part of the maggot is so fixed, that it can draw its cell after it any where without danger of leaving it behind, as also to thrust out its body to reach what it wanteth, or withdraw it into its cell to guard it against harms."

From this quotation a general idea may be obtained of the cases of these insects, but it is also worthy of notice, that it not unfrequently happens that small shells are affixed to the case; and it appears that the caddiee worm does not hesitate to seize upon them for its own purpose, even although they enclose living snails. Some species likewise are encased in a tube formed of a slender and narrow bit of grass, which they are enabled to roll in a beautiful spiral direction, the edges being so nicely fitted as to have the appearance of one continuous piece. In some modern popular works on insects, the various kinds of caddice worms are spoken of as constituting but one species, not at all choice in the ornaments with which it decorates its coat. As, however, there are nearly two hundred British species of the Linnæan genus *Phryganea* indicated by Mr. Stephens, it is not to be doubted that each of the varieties of cases belongs to a distinct species. Sir John Hawkins has indeed given a classification of the former, but it still remains for the entomologist to complete the table by the introduction of the different species of flies produced from the different kinds of cases. These cases are of the greatest service to the larvæ, the latter being very tender and soft, with the exeeption of the head and two first segments of the body, which are the only portions which are generally exposed in walking, the insects retain their situations in the case by means of two hooks at the extremity of the body, with which they keep their hold so firmly, that it is almost impossible to draw them out of their cases without hurting them. When full grown, these larvæ, in the first place, attach their cases to some large stone by threads, they then close the mouth of the case with an open net-work of threads, suffieiently close to prevent the entrance of insects, but with meshes permitting the water to run in. They then shed their skin, and appear as quiescent pupæ, having their limbs enclosed in distinct cases, and being furnished with a pair of small fleshy tubercles at the posterior extremity of the body, and two small hooks at the head, whereby, previous to arriving at the perfect state, they cut the threads of the mouth of the case, and being then (in a manner totally different from the majority of pupæ) endowed with powers of locomotion, they creep out of the water, shortly after which they cast off their pupa skin, and appear as perfect *Phryganeæ*.

CÆLESTINA (Cassini). A family of herbaceous and half shrubby perennials, natives of America. Linnæan class and order *Syngenesia æqualis;* natural order *Compositæ*. Generic character: involucrum cylindrical, many leaved, imbricated; receptacle convex, naked; florets all tubular; stigmas very long; pericarpiums five-cornered; pappus a membranous rim. These plants, of which there are three species, are kept in the greenhouse, where their bright blue flowers are highly ornamental.

CÆNOPTERIS (Bergius). A New Holland fern, formerly called *Asplenium*. There are two species.

CÆSALPINIA (Plumier). A genus of hot-house trees and shrubs, natives of the East and West Indies. Linnæan class and order *Decandria Monogynia;* natural order *Leguminosæ*. Generic character: ealyx five parted, lowest segment large and vaulted; corolla of five petals; stamens downy at the base; style filiform; stigma truncated and fringed; pod and seeds compressed. This family of plants is celebrated for the hardness and durability of its wood, and for its uses to the dyer. It makes the best trenails for ship-building. Both the *C. crista* and *Brasiliensis* yield the Brazil wood used in dyeing, though that of the *C. echinata* is said to yield the finest colour. The plants are thorny, and seldom flower in our stoves; they are propagated by cuttings, but with difficulty.

CÆSIA (R. Brown.) A bulbous rooted herbaceous plant from New South Wales. Linnæan class and order *Hexandria Monogynia;* natural order *Asphodeleæ*. Generic character: corolla of six spreading equal petals; stamens below the germen, having smooth filaments; anthers erect and margined at the base; style filiform; seed-vessel clubbed, of three cells with two seeds each; seeds bellying.

CÆSULIA (Willdenow). An inconspicuous creeping syngenesious plant found in India, never cultivated.

CAIRNGORUM STONE. The rock or mountain crystal known under this name is in reality a very beautiful form of rhomboidal quartz, procured in different parts of Scotland, but originally found in the greatest quantities at Cairngorum, in the county of Moray. The mountain stores are now nearly exhausted, and they are only rarely obtained among the debris washed down by the winter's torrent. The deep wine-yellow and clove-brown coloured varieties, are those most highly esteemed by colleetors, and those are the eolours usually made up into neeklaces, seal-stones, and brooches. It is an excellent stone for engraving upon, and on this account it is much sought after by the lapidaries. The rock-crystal of Brazil and Madagascar is in general of a deeper tinge than that of Scotland, and can be purchased at a cheaper rate. The consequence of this is, that many of the Brazilian pebbles are sold under the name of Cairngorum stones. The various degrees of hardness whieh distinguish mineral bodies furnish the collector with valuable data by which he is enabled to distinguish one mineral from another. Thus the Cairngorum stone is sometimes sold for the topaz; but if the one be brought in contact with the other, the topaz will act on the Cairngorum stone, but the latter will not scrateh the topaz. Another test is, that the topazes of Brazil and Siberia beeome electrical by simply raising their temperature, which is not the case with the Cairngorum stone.

There is a process sometimes resorted to by dealers in this mineral which very materially changes its external appearance. It consists in raising its temperature almost to a red heat, and then plunging the crystal into different coloured solutions, such as indigo or cochineal, and by this means the most beautiful tints are produced.

CAKILE (Tournefort). The sea-rocket, a plant indigenous to Britain, and in some places common on the sea-shore. It belongs to the class *Tetradynamia* of Linnæus, and the *Cruciferæ* of Jussieu.

CALABASH TREE is the *Crescentia cujete* of Willdenow and other botanists. The fruit are large, and either oval or round. When the pulp is scooped out the skin becomes so hard as to serve the purpose of bottles, basins, or other vessels. The plant is common in the West Indies.

CALADENIA (R. Brown). A tuberous rooted, green-house perennial from New Holland. Linnæan class and order, *Gynandria Monandria;* natural order, *Orchideæ.* Generic character: perianth gaping, of five sepals, glandular, upper one plane, four lower ones nearly equal; labellum hollow, clawed, somewhat three-lobed; disk ornamented with a series of glands; column membranaceous, dilated; anthers terminal and persisting.

CALADIUM (Willdenow). A genus of plants allied to the Arums. Linnæan class and order *Monœcia Polyandria;* natural order *Aroideæ.* Generic character: male flowers have neither calyx nor corolla; anthers many celled, disposed in a spike at the end of the spadix: females, no calyx nor corolla; seed-vessel attached to the base of the spadix; style none; berry one-celled, one-seeded. The plants have large triangular or arrow-head shaped leaves and spotted stems. The species called *Sagittifolium* is like the *Arum colocasia,* and is called by the French *Chou de Bresil,* because they, like those of the *C. esculentum,* are used like cabbage. The roots of the sagittifolium are large tubers, and are a favourite vegetable among the Chinese, who cultivate them extensively. Most of these plants have a strong bitter principle, which is dissipated by cooking, whether boiled or roasted.

CALAMAGROSTIS (Adanson). A family of European uncultivated reeds or grasses. Linnæan class and order, *Triandria Digynia;* natural order, *Gramineæ.* They are mostly found on bogs and moist ground; three of them are British.

CALAMINE. This mineral forms the basis of zinc, and is used to a great extent in the manufacture of brass. Calamine is the *zink-baryt* of Mohs, and is usually divided into two species, the prismatic calamine and the rhomboidal calamine. The first of these is usually of a white or yellow colour, occasionally passing into green. Its primitive figure is an oblique four-sided prism, levelled on the extremities. The crystallised varieties are much harder than those that are massive and opaque. When gently heated, the prismatic calamine is strongly electric, hence its name *electric calamine.* It occurs in many parts of England, especially in the lead mines at Wanlockhead; and also in Leicestershire and Flintshire. On the continent it is met with at Tarnowitz in Silesia, Tscheren in Bohemia, Rezleanya in Hungary, Bleiberg in Carinthia, Freyburg in the Bresgau, and Stolberg in the Tyrol. The rhomboidal calamine occurs to a considerable extent in the Mendip Hills, in Durham, Flintshire, and Derbyshire. It is also found on the continent of Europe, and at Alta in Siberia. The primitive figure is a rhomboid.

CALAMINTHA (Pursh). The common calamint, an inhabitant of our flower borders, natives of Europe. Linnæan class and order, *Didynamia Gymnospermia;* natural order, *Labiatæ.* Generic character: calyx after flowering closed by hairs; orifice of corolla inflated, upper lip emarginate; the lower three-parted, with the intermediate segment entire. This genus is allied to our common thyme, and ranks among pot-herbs, but is seldom used.

CALAMUS (Willdenow). The rattan reed, a native of the East Indies. Linnæan class and order, *Hexandria Monogynia;* natural order, *Palmæ.* Generic character: perianth chaffy, irregular; sepals six; berry dry, one-seeded, imbricated backwards. This genus is said to form the link between the palms and grasses; having the inflorescence of the former, and habit of the latter. The stems are regularly jointed, solid, and extremely tough, so that they are extensively used for binding bundles of goods, &c. They also furnish the beautiful walking sticks called rattans; and in India, where they grow spontaneously by the sides of rivers, the stems are put to many useful purposes. The Chinese prepare great numbers for exportation to Europe and America. The *Calamus Zalacca* is cultivated for the fruit, which is about the size of a walnut, containing two or three sweet kernels.

CALANDRA (Clairville). A genus of coleopterous insects belonging to the section *Tetramera,* and family of the weevils, having the antennæ strongly elbowed, the eighth and ninth joints forming a triangular or ovoid mass, the elytra shorter than the abdomen, and the body narrow and somewhat depressed. This is a genus of very destructive insects, the larvæ feeding upon various seeds and grains. Of these, the most injurious is, doubtless, the *Curculio granarius* of Linnæus, a minute species, not exceeding one-sixth of an inch in length, of a dark pitchy red colour; the thorax is punctured, and as long as the elytra, which are adorned with several rows of deeply impressed dots. This insect, which is called the corn weevil by the English, charançon du blé by the French, and gwyfyn-yr-yd by the Welsh, feeds, both in the larva and perfect state, upon housed grain; its ravages were evidently known in the days of Virgil, by whom it was called *Gurgulio*—
' Populatque ingentem farris acervum gurgulio."

M. Keferstein has recently published a series of experiments upon this insect in the ninth number of the Revue Entomologique de Silbermann, 1834, which cannot fail to interest our agricultural readers. The female deposits her eggs at one end of the grain of corn, from whence, when the larvæ is hatched, it works internally, so that it is impossible to know whether the grain be sound or not; generally each grain contains but a single grub, but sometimes there are two. The larvæ resembles that of the nut weevil, *Balanenus nucum,* being white, with a brown head, and destitute of legs. When the entire of the farinaceous matter of the grain is consumed, and a mere husk remains, the larva is transformed into a pupa of a white colour, in which all the parts of the future weevil are plainly to be perceived. The latter, in general, makes its appearance at the end of eight days, piercing a round hole through one end or the middle of the grain. At the approach of winter it descends into the ground, a circumstance of much importance, appearing again about Easter, and making its way to the granaries. From the various experiments made by M. Keferstein, he is induced to draw the following, amongst other, results, viz., that the duration of the life of the perfect insect does not extend beyond one year; that those insects of an advanced age are incapable of reproduction; that during the cold the ravages of these insects are stationary, reproduction not taking place during the winter, but only in warm weather, although it is dependent upon several circumstances not yet sufficiently understood; that the egg or larva of the insect may at times be observed in the grains during the winter, although in very small quantities; and hence, that corn, purchased in the winter months, cannot be considered as entirely free from the weevil.

Other species of this genus are scarcely less destructive than the preceding. One of these (*Curculio oryzæ* Linnæus), which nearly resembles the *C. granaria*, but has a yellowish spot on each wing cover, feeds upon grains of rice. A third (*Curculio palmarum*, Linnæus), whose size being an inch and a half long, renders it a most formidable enemy, lives in the palms of South America, where its larvæ are greedily sought after and devoured by the inhabitants. The same insect, as we are informed by the late Rev. Lansdown Guilding (in his Memoir upon the insects which attack the sugar cane, for which he was, in 1831, honoured by the Society of Arts with the gold Ceres medal), is also injurious to sugar cane plants lately stuck in the ground, to which the females are allured by the juices which are exuded. These they sometimes attack so vigorously, that a fresh planting becomes necessary. They, however, do not seem to deposit their eggs in full grown canes when palms are abundant in the neighbourhood. Another, but smaller species, *Calandra sacchari* of Guilding, in like manner attacks the cane, but confines itself principally to such plants as have been slightly injured, though it sometimes attacks the more vigorous plants, which it excavates to the very ground. The larvæ of these two species, unlike the corn weevils, form very perfect cocoons.

The only other species which we shall here notice is the *Calandra tamarindi*, described by Mr. Christy in the first number of the Transactions of the Entomological Society, and which was found in a dead state in the interior of the stones of prepared tamarinds, sometimes amounting to as many as thirty or forty in a single stone. How the insects found their way into the stones is a curious point for inquiry, since the latter exhibited no traces of puncture in the epidermis. Can it be, as Mr. Christy pertinently asks, that the female deposits her eggs in the fruit when very young, or in the germen when in flower? This knowledge, however, can only be obtained by observations made upon the growing plants in the West Indies.

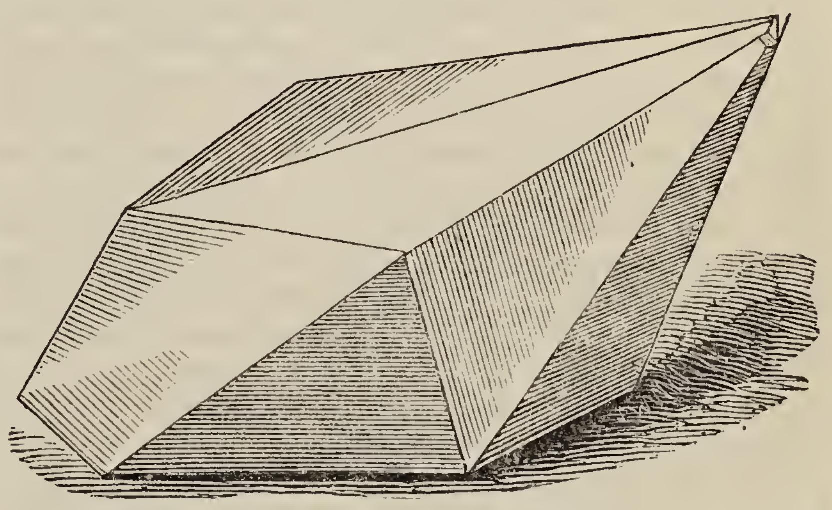
CALANDRINIA (Humboldt). An ornamental genus of herbaceous plants from South America. Linnæan class and order, *Dodecandria Monogynia*; natural order, *Portulaceæ*. Generic character: calyx of two persisting sepals; corolla of from three to five equal petals; stamens inserted into the bottom of the petals, in number four to six; filaments dilated at the base; anthers two-celled; style simple; stigma three-parted; seed-vessel elliptical, covered by the persisting calyx, one-celled, three-valved; many-seeded; placenta central. These rather showy plants have been but lately introduced into British collections, but they flower freely and are much admired.

CALANTHE (R. Brown). An orchideous genus lately introduced from India. Linnæan class and order, *Gynandria Diandria*; natural order, *Orchideæ*. Generic character: sepals distinct, upper ones erect, laterals declining; labellum spurred, appended to the column, hairy, three-lobed, middle lobe cleft; column obovate, turbinate; anthers behind. This, like all the others of its order, has flowers of the most curious structure, though not so varied in colour as some others. They are terrestrial plants, and may be cultivated like cymbidium.

CALATHEA (Meyer). A genus from Brazil, allied to the arrow-root plant. Linnæan class and order, *Monandria Monogynia*; natural order, *Canneæ*. Generic character: anther attached to a petal-like filament; style shaped like a petal; stigma like a cup. Flowers in close heads. The leaves of this plant are curiously striped green and white, hence the specific name *Zebrina*. It was formerly known by the name of *Maranta zebrina*.

CALATHIAN VIOLET is the *Gentiana pneumonanthe* of botanists, belonging to a beautiful tribe of herbaceous perennials cultivated in flower gardens. The tuberous roots are used in medicine.

CALCAREOUS SPAR. This beautiful mineral, which is in fact a crystallised carbonate of lime, occasionally combined with other bodies, occurs very abundantly in many parts of the world. The crystalline masses which are procured in Derbyshire are found in most mineralogical collections. Calcareous spar generally occurs of a white colour, inclining to red and grey. It is also frequently seen of a wax or ochry yellow colour; but the white and grey varieties are usually massive. Its primitive form is a rhomboid, but imagination can scarcely paint any thing more beautiful than the stalactitic varieties which are occasionally found in its natural state. It will only be necessary for us to furnish a graphic illustration of one form of this crystalline body. It is copied from a specimen in the British Museum, brought from Derbyshire.



Calcareous Spar has three characteristic forms, which may be briefly enumerated. The first in which it occurs is an acute double six-sided pyramid; in the second, it forms an equiangular six-sided prism, including the six-sided table; and in the third, it forms a rhomboid.

An interesting geognostic character of calcareous spar is the uniformity of its crystallisations in particular districts. Thus, in the mines of Derbyshire, the acute six-sided pyramid, and its congenerous forms, are the most frequent and abundant; at Schneeberg, in Saxony, and in the Upper Hartz, the prevailing forms are the regular six-sided prism and table; while in the mines of Freyberg, the most frequent forms are the regular six-sided prism, acuminated with three planes, set on the lateral planes, and the flat double three-sided pyramid.

The oldest formation of this mineral is that in veins, where it is accompanied with felspar and rock-crystal. It occurs also in beds, along with augite, hornblende, garnet, and magnetic ironstone, and frequently in veins in different metalliferous formations

Thus, it is associated with nearly all the metallic minerals contained in gneiss, mica-slate, clay-slate, and porphyry; seldomer in granite, more frequently, again, in greywacke, and along with cobalt and copper-ores in the oldest secondary limestone. Veins, almost entirely composed of calcareous spar, abound in the newest limestone formations; and it is a common mineral, either in veins, or in contemporaneous masses, in the various rocks of the secondary or flœtz-trap series.

CALCEOLARIA (Linnæus). Slipperwort, a handsome family of flowering plants, natives of Chili. Linnæan class and order, *Diandria Monogynia;* natural order, *Scrophularinæ.* Generic character: calyx four cleft, corolla gaping and inflated, capsule two-celled and four-valved. This genus has received its name from the remarkable shape of the inflated corolla resembling a shoe or slipper. Some of them are tender annuals, others deciduous under-shrubs. Two species have been long known in British gardens, but a great accession has been made within the last twelve years. From these last many varieties have been obtained by cross impregnation, so that they are now numerous. Above forty sorts are now cultivated and highly ornamental to the flower borders in summer, and greenhouse in autumn. Some of them will stand through the winter if placed in pots and kept in a cold frame; or if, in the open borders, they be sufficiently protected against severe frost. They, however, flower much better by having a good situation in the greenhouse or conservatory during winter.

All the annual species and varieties should be sown raised and treated exactly like what are called "tender annuals," such as the balsam, cockscomb, amaranthus, &c., pricked out from the seed-pans into very small pots, and repeatedly shifted into larger and larger up to twenty-fours, in which they may flower. Such of them as are biennials, as the *C. floribunda,* are best sowed in September and treated like greenhouse plants. The perennial species are propagated by division of the roots, and by cuttings and seeds, so are also the half shrubby species. Seeds sown as they ripen flower in the following summer; but not so strong as if sown in the spring, and not allowed to flower till the second summer.

CALDASIA (Willdenow). An ornamental hot-house annual belonging to the fifth class of Linnæus, and natural order *Polemoniaceæ.* It has pretty blue flowers, and is propagated by cuttings.

CALEA (R. Brown). A genus of hot-house evergreen shrubs, natives of the West Indies. Linnæan class and order *Syngenesia Æqualis;* natural order, *Compositæ.* Generic character: involucrum imbricated, receptacle chaffy, pappus hairy. The leaves are entire, and the flowers are yellowish purple, growing in terminal or axillary heads.

CALEACTE (R. Brown). A syngenesious plant found on the sea shore about Vera Cruz. This plant was formerly called *Solidago urticifolia.*

CALEMPELIS (D. Don). A perennial greenhouse climber from Chile, formerly called *Eccremocarpus* by Ruiz and Pavon. Linnæan class and order, *Didynamia Angiospermia;* natural order, *Bignoniaceæ.* Generic character: calyx bell-shaped, limb four or five parted, spreading; corolla tubular, upper part swollen, contracted at the mouth; limb short, in five reflexed lobes; stamens included; anthers free, fleshy and parted at bottom; stigma two-plaited; seed-vessel oval, compressed, one-celled, two-valved; seeds with membranous wings. This is a showy green-house plant, and seen in most collections.

CALEPINA (Adanson). A cruciferous annual plant heretofore called *Myagrum iberiodes.* It is a native of the south of Europe.

CALEPTERYX (Leach). A genus of Dragon Flies. See Agrionidæ.

CALEYA (R. Brown). Tuberous rooted plants from New Holland. Linnæan class and order *Gynandria Monandria.* Natural order *Orchideæ.* Generic character: calyx of five sepals nearly equal, and narrow; labellum clawed behind; lamina peltate, eaved; columna naked, somewhat dilated; anthers terminal; pollen in two masses.

CALIGIDES (Latreille). A family of parasitic *Crustacea,* belonging to the section *Entomostraca Siphonostoma,* or those which have the mouth formed into a sucker. The body is covered by an oval or semilunar shield, flattened above, with twelve legs, the four last pairs of which are feathered and pinnate, being admirably formed for swimming. The tail is more or less elongated and exposed, and terminated by two appendages. This family comprises only two genera, *Argulus* and *Caligus.* The first of these is established for the reception of a small but very curious (British) animal found upon various small fresh-water fish, upon the blood of which it subsists, sometimes to the destruction of its victim. It is the *Monoculus Foliaceus* of Linnæus, and its natural history and structure, in the different stages of its existence, have been detailed by the younger Jurine in the most satisfactory manner in the seventh volume of the Annales du Museum d'Histoire Naturelle. The insect is nearly a quarter of an inch long, and the body is covered with a large flattened, and nearly circular and transparent shield (through which the organs of the under side of the body may be seen), having two eyes near the front margin. It is notched behind, discovering the abdomen, which is extended beyond it to a short distance. The mouth is formed for suction. There are four small inferior antennæ. The legs are of singular construction; the first pair are large and short, and shaped somewhat like a cup, since it is by these organs, which probably act like a cupping machine, that the insect attaches itself to small fish. The four hind pairs of legs are formed for swimming, each being terminated by two long-feathered filaments. The young resemble their parents in form, though their locomotive organs are very differently constructed. The other genus, *Caligus,* is destitute of the large cup-shaped feet, the anterior pair being hooked. The tail is long, and terminated by two very elongated processes in the females, of which the use has not yet been determined. These animals are termed fish-lice, being parasitic upon various kinds of fishes. The genus has been subdivided into several sub-genera by Leach and Latreille.

CALLA (Linnæus). A genus of perennial herbaceous plants, natives of different parts of the world. Linnæan class and order, *Heptandria Monogynia;* natural order, *Aroideæ.* Generic character: spatha of one leaf; spadix cylindrical, and covered with styles and stamens; antheræ twinned and two-valved; stigmas sitting; fruit a berry containing strong-scented seeds. These plants in habit resemble the arums. The *Calla Æthiopica,* now called *Richardia Æthiopica,* is one of our commonest green-house plants, and very often seen ornamenting cottage windows. Its arrow-head-shaped leaves, elevated on long footstalks, surrounding its large trumpet-shaped white flower, is in figure very like that of the common spotted arum, called cuckoo pint, or wake Robin, frequent under hedges in many parts of Britain.

CALLICARPA (Linnæus). A genus of shrubby plants, natives of America, China, and the East Indies. Linnæan class and order, *Tetrandria Monogynia;* natural order, *Verbenaceæ.* Generic character: calyx of four sepals; corolla limb somewhat bell-shaped, with the border in four lobes; stamens protruding; berry four-seeded.

CALLICERUS (Gravenhorst). A small but curious genus of Rove-beetles (*Brachelytra*), belonging to the family *Aleocharidæ*, at once distinguished by the great length of the two last joints of the antennæ, and by the large oval penultimate joint of the palpus. The type *Callicerus Spencii*, named in honour of Mr. Spence, is exceedingly rare in England, but was captured, during the course of the last season (1834), in Battersea-fields.

CALLICOMA (Botanical Repertory). Of this genus there is only a single species, a native evergreen shrub from New South Wales. Linnæan class and order, *Dodecandria Digynia;* natural order, *Cunoniaceæ.* Generic character: calyx of four sepals; stamens below the germen; filaments long and hair-like; anthers oval, fixed by the back, two-celled; style divaricate; fruit two-seeded. Flowers are collected in heads, having an involucrum of four leaflets. This is an elegant green-house plant.

CALLIDIUM (Fabricius). A very extensive genus of beetles, belonging to the section *Tetramera*, and family *Cerambycidæ:* and distinguished by the comparative shortness of the antennæ, which are filiform rather than setaceous. The thorax is not armed at the sides with spines, being either globose, orbicular, or subcylindric, and (in the latter case) only slightly dilated at the sides, the palpi are short, and terminated by a somewhat triangular joint. Some of the species, which are generally of a moderate size, are elegantly ornamented with bands of various colours, whilst others are entirely of a red, or violet colour. They are found amongst timber, and it is not improbable that some of the species admitted into our catalogues have been imported in foreign timber, as is the case also with some of the *Buprestidæ;* others, as *Callidium bajulum*, are extremely destructive, the larvæ boring through posts, rails, &c. It is likewise very injurious to the rafters of houses, the larvæ making its way, by means of its powerful jaws, even through leaden coverings.

CALLIGONUM (Linnæus). A genus of one species, which is an ornamental under shrub. Linnæan class and order, *Dodecandria Tetragynia;* natural order, *Polygoniæ.* Generic character: calyx of five obtuse, reflexed, persisting sepals; corolla none; stamens inserted in the base of the calyx; filaments persisting; styles three or four, bearing stigmas; nut four-sided, four-winged, one-seeded, sometimes spinous.

CALLIMORPHA (Latreille). A genus of lepidopterous insects, as the name implies, of very elegant appearance, placed by Mr. Stephens in the family *Lythosiidæ*, but by Latreille amongst the *Pseudo-Bombyces.* The wings are deflexed (being somewhat of a triangular form); the antennæ are only ciliated in the males; the palpi are three-jointed, and but slightly clothed with small scales; and the spiral tongue is longer than the head. The type of the genus is the pink under-wing moth, a handsome, although common species, having the upper wings black, with a line and two spots crimson, the under wings of the latter colour bordered with black. The larvæ are slightly hairy, of a black colour, with yellow rings. It feeds upon the *Jacobæa Senecio.* The moth is stated to appear in May, but we have found it throughout the summer.

CALLIONYMUS (Dragonet). A genus, or, in its largest sense, a group of acanthopterygious fishes, belonging to the *Gobioidæ*, or gudgeon family, in Cuvier's arrangement. They have two very well marked characters; first, their gill-openings consist of only a hole on each side of the neck; and, secondly, their ventral fins are placed immediately on the throat, much extended and widely spread, and very considerably larger than the pectorals. Their head is oblong, and much depressed or flattened. Their eyes are placed near to each other, and directed upwards; their muzzle is capable of considerable protrusion; their gill-flaps are much extended backwards, and terminate in spines. They have no teeth in the palate. Their colours are in general brilliant, and often strongly contrasted. Their skin is smooth. Their first dorsal fin is supported by setaceous rays, which are often very much produced, and give their profile or side view a very peculiar appearance; their second dorsal extends as far as the anal; and they have a produced appendage behind the vent. They have no air-bladder. There are several species, or perhaps genera, not more than one of which is found, or at least common, in the British seas. That one is

C. Lyra (the gemmous dragonet). This species has the first ray of the first dorsal fin extending as far as the tail, the fin itself being much elevated. It is usually about a foot long, with the body rounded and smooth, the mouth wide, the gill-flaps with spines, and the last rays of the second dorsal and the anal fin the longest. Its colours are very bright, the prevailing one is yellow, but there are spots of white, and very bright ones of blue and purple. On the English coast, it is generally called the yellow gurnard, and on that of Scotland, "gowdie" (golden). A variety has been described as *C. dracunculus*, which has the same general characters and nearly the same colours, but the first ray of the dorsal fin is very considerably shorter. It has been supposed that this is the female of the other variety; and there is some probability in the supposition. This is perhaps the case with many of our rarer fishes; and therefore those who obtain specimens should always be careful to ascertain the sex, in order to prevent each sex from being regarded and described as a species. In this family in particular, and indeed in all fishes which have produced rays, or other appendages of which the use is not very well ascertained, there is generally some difference in those parts of each sex.

In the warmer seas, the Mediterranean especially, or rather because the fishes of that sea are more accessible, and have been longer observed than those of the wide oceans, there are some other species, among which we may notice

C. Lacerta, which has the first dorsal very much lower than in the former species, and the second (in the male) very much higher; and the caudal fin long and pointed. The sides are marked with lines of black and white, and with silvery spots.

The other divisions of the group which have received generic names are, *Trichonotus* and *Comephorus*.

The first of these do not differ very much from the dragonets, properly so called, only their bodies are more elongated in proportion to the thickness; but they have but one dorsal fin; the dorsal and anal fins are proportionally longer, and the first two rays of the dorsal are produced in slender filaments, which may be considered as answering to the first dorsal of the true dragonets. The *Trichonotus setigerus* of Bloch, is the species of this division which is best known.

Of *Comephorus* there is only one species, a native of the lake of Baïkal in Siberia, and is only known from specimens which are cast on the shores of that lake dead, after the violent storms by which its waters are often agitated. This is *Comephorus Baïkalensis* (*Callionymus Baïkalensis* of Pallas). It is about a foot long, soft and fat in its substance, so much so, that they who pick it up on the shores press it on account of the oil which it contains. It has two dorsal fins, the first very low; the muzzle large, oblong and depressed; the gill-flaps containing seven rays, very much divided from each other; the pectoral fins very long; but, different from all the rest of the family, there are no ventral fins.

CALLIOPEA (D. Don). A hardy perennial, a native of Italy. It belongs to *Syngenesia Æqualis*, and to the natural order *Compositæ*. This plant was thought to be a *Leontodon*, by Linnæus; and by others a *Hieracium*.

CALLIOPSIS (Reichenbach). A genus of ornamental annual and perennial herbs, natives of America. Linnæan class and order, *Syngenesia Frustranea;* and natural order, *Compositæ*. Generic character: involucrum of many leaves; leaflets short and erect; anthodium of many parts, and coloured; receptacle chaffy, and bearing protuberant glands; florets dilated at the base, and unequally toothed at top; seeds oblong and cylindrical. The genus has been separated from among the coreopsis family.

CALLISACE (Fischer). An obscure umbelliferous perennial from Siberia.

CALLISIA (Linnæus). A genus containing a single species; a creeping perennial from the West Indies. It belongs to *Triandria Monogynia* of Linnæus, and the natural order *Commelinaceæ*. The flowers are pretty, on which account it has been long introduced into European collections.

CALLISTACHYS (Ventenat). A genus containing four or five species of New Holland ornamental shrubs. Linnæan class and order, *Decandria Monogynia;* and natural order, *Leguminosæ*. Generic character: calyx, bell or funnel-shaped, cut into long slender divisions; corolla, petals inserted in the calyx, clawed, the upper large, the lower small, and standing apart; stamens inserted in the calyx, declining; anthers longish, and somewhat incumbent; style long and protruding; stigma capitate; germen stipitate; pod long, many seeded. These plants are usually found in green-house collections.

CALLISTEMA (Cassini). A genus of annuals long cultivated in European flower-gardens under the name of China-asters. Linnæan class and order *Syngenesia Superflua;* natural order, *Compositæ*. Generic character: anthodium loosely imbricated, rather foliaceous; receptacle hairy; ray of two colours; pappus double; exterior chaffy, the interior downy. No plant is better known than the China-aster as Linnæus called it. It ranks among those exotics called tender annuals, and as such are raised from seeds (which ripen in this country) in hot beds in the spring, and transplanted into beds or borders during summer, to flower in the autumn. Of late years, many new varieties have been raised from seed, beautifully varied in colour, having a greater number of ligulate florets, and the whole flower much increased in size, and even vying with those of the dahlia. The China-aster, or starwort, has always been regarded for its late flowering, it being one of the principal ornaments of the flower-garden when but few other flowers are to be seen.

Notwithstanding this exotic was introduced from China above a century back, it does not appear to have gained any greater degree of hardihood, from its long sojourn in Europe, than it had at first; so that the idea of the possibility of acclimating plants of warmer countries to the colder temperature of this, does not hold good with respect to the plant under notice.

CALLISTEMON (R. Brown). A genus of beautiful shrubs introduced into our collections from New Holland. Linnæan class and order, *Icosandria Monogynia;* and natural order, *Myrtaceæ*. Generic character: calyx with a hemispherical tube, and the margin divided into five lobes; corolla of five petals; stamens numerous, seated in the throat of the calyx, clongated; style filiform; stigmas headed; capsule three-celled, containing many seeds thickened and united to the tube of the calyx. The callistemons were first included in the genus *Metrociderος*, but separated by Dr. Brown. They are all fine greenhouse plants, partaking of the essential qualities and general appearance of their type, the common myrtle.

CALLITRICHINEÆ. A natural order of dicotyledonous plants, containing only a single genus, and three or four species. It is allied to the *Halorageæ*, and by many authors is looked upon merely as a section of that order.

The characters of the order are,—flowers monœcious, naked, furnished with two-coloured bracteæ; one stamen, consisting of a thread-like filament, grooved along the middle, and a kidney-shaped, one-celled anther; ovary solitary, four-cornered or four-celled; two awl-shaped styles; fruit four-celled, four-seeded, and indehiscent; seeds shield-shaped.

The plants included in this order are aquatic herbs, having entire opposite leaves, and very minute axillary flowers. They are said to exhibit the lowest degree of organisation in the dicotyledonous class of vegetables. They are found in still waters in Europe and America.

The only genus is *Callitriche*, or water star-wort, of which there are three British species, *verna*, *pedunculata* and *autumnalis*. These plants vary much in appearance, according to the depth and stillness of the water in which they grow. They are frequently met with in ditches and pools, to which, along with the various species of duckweed, they give a green and often thick covering.

Their properties are still unknown.

CALLITRIS (Ventenat) is a genus allied to the pine family, a native of New Holland. Linnæan class and order, *Monœcia Monadelphia;* natural order, *Coniferæ*. Generic character: male flowers in a small ament or catkin, somewhat round, with peltate scales, containing from two to five stamens united in a brotherhood; female flowers have a convex receptacle, with a double series of scales arranged circularly; germens numerous, sitting within the scaly calyces.

This tree has been hitherto kept in our greenhouses, and it is at present doubtful whether it may be naturalised in this country.

CALLORHYNCHUS. A genus of cartilaginous fishes, belonging to the *Chimæra* family, and containing only a single species (*C. antarcticus*), the Southern Chimera. The principal characters are: only one apparent breathing hole on each side of the body, though there are five which unite in that one, each leading to one of the cells in which the gills are contained (see CHONDROPTERYGII and FISH, for the structure of the breathing apparatus of the order); they have a rudimental gill-lid contained within the skin; their jaws are much smaller, and less capable of extended opening than those of the sharks; and they have, instead of teeth, four broad plates on the upper jaw, and two on the under. They have the muzzle produced considerably in advance of the mouth, as in the sharks; but it is perforated with pores in all the family. This formation of the muzzle gives them a very singular appearance, and has procured for them the name of Chimæra. In the species, or rather genus, under consideration, it is extended in a flat lamina, of the form of a spade or hoe, and of a fleshy consistency. There are two dorsal fins, the second commencing immediately over the ventrals, and ending over the commencement of that under the tail. They are found in the warm seas, and are ranging or discursive fishes.

CALLUNA (Salisbury). A new generic name given to one of our commonest heaths, which was supposed to be somewhat different formed from the generality of the heath family; but the name is not adopted.

CALOCHILUS (R. Brown). A new genus belonging to the *Orchis* family, introduced from New Holland. Linnæan class and order, *Gynandria Monandria;* natural order, *Orchideæ.* Generic character: calyx a ringent perianthemum, lateral sepals seated on the outside of the labellum, the inner ones sitting, small and erect; labellum sitting, elongated, pointed, and bearded; anthers parallel with the stigma. Like others of this curious order, the roots are tubers, and the plant requires greenhouse treatment.

CALOCHORTUS (Pursh.). A genus of bulbous rooted beautiful plants, from Columbia. Linnæan class and order, *Hexandria Trigynia;* natural order, *Liliaceæ.* Generic character: calyx of three sepals, coloured within; petals of the corolla inversely egg-shaped, bearded within; stamens short, and seated under the germen; filaments plane; anthers erect and arrow-shaped; stigmas recurved; capsule three-celled; seeds smooth. This is a very remarkable kind of lily; the flowers are splendid, though fugitive, but succeed each other for a considerable time.

CALODENDRON (Thunberg). This is, as its name imports, a beautiful tree, a native of the Cape of Good Hope. Linnæan class and order, *Pentandria Monogynia;* natural order, *Rutaceæ.* Generic character: calyx five-parted; petals of the corolla clawed; stamens alternately sterile and fertile, glandular at the apex; fertile stamens tuberculated; anthers bearing glands; style simple; capsule five-celled, five-valved, and cell containing two seeds. This tree is in European collections, and has a place in the greenhouse.

CALOPHACA (Fischer). A leguminous plant found in Siberia, allied to the *Cytisus,* and with which it has been ranked by Linnæus, and several other botanists.

CALOPHYLLUM (Linnæus). A genus of timber trees indigenous to the East Indies. Linnæan class and order, *Polyandria Monogynia;* natural order, *Guttiferæ.* Generic character: calyx of from two to four sepals; corolla of four petals, somewhat round, spreading; stamens numerous, and inserted below the germen; filaments like threads, slightly united at the base; anthers oblong and erect; style simple; stigma concave; drupe fleshy, globular, one-seeded; putamen fungous within. These are highly ornamental trees, both flowers and foliage being handsome; their juice is resinous, and applied to several useful purposes. In British collections they are kept in the hothouse, and are propagated by cuttings or layers.

CALOPOGON (R. Brown). So called from the lip of the flower being beautifully bearded or fringed. Linnæan class and order, *Gynandria Monandria;* natural order, *Orchideæ.* Generic character: calyx a perianth of five sepals; these are lance-shaped, the exterior ones oblique, the interior narrow: the labellum behind, clawed; the limb bearded; column jointed, incurved, winged at top; anthers terminal. This plant was long known in collections as the *Limodorum tuberosum,* and is well worth cultivating.

CALOSOMA (Weber). A very splendid genus of beetles belonging to the section *Pentamera,* and family *Carabidæ,* or Ground Beetles. It is distinguished from the true *Carabi* by being winged. The jaws are without teeth; the abdomen is broad, the maxillary palpi terminate in a large joint; and the four posterior tibiæ are curved in the males of some of the species. These insects are of highly-polished and metallic colours, and, unlike the majority of the family to which they belong, they are found in trees, notwithstanding their large size; hence the necessity of their being furnished with wings is perceived, and hence one of the incidental connexions between the splendour of their colouring and the exposed nature of their habits. Thus, if we look throughout nature, we find that, in every group of animals, those species which are more especially exposed to the light are more gaily ornamented with colours; and this generally holds good even between those species which reside in temperate climates and those which are exposed to the blaze of the tropical sun. The *Calosoma sycophanta* (Linnæus) is nearly an inch long, with the head and thorax of a fine dark blue, and the elytra of a rich copper colour. Its larva lives in the nests of various gregarious caterpillars, upon which it feeds, gorging itself to such a degree as to fall an easy prey to younger larvæ of the same insect. The perfect insect, as well as the other British species, *Calosoma inquisitor,* are generally found in oak-trees, but both are rare in this country. The genus is widely distributed, and Dejean enumerates twenty-eight species.

CALOSTEMMA (R. Brown). A bulb from New Holland, cultivated as a green-house plant. Linnæan class and order, *Hexandria Monogynia,* natural order, *Amaryllideæ.* Generic character: perianth funnel-shaped, six-parted; the crown, or nectarium is within the tube, twelve-toothed, each alternate one awl-shaped, and bearing versatile anthers; style filiform; stigma obtuse; berry roundish, with one seed. This bulb like others, is propagated by off-sets.

CALOTHAMNUS (Labillardiere). A genus of handsome New Holland shrubs, introduced into England about thirty years ago. Linnæan class and order, *Polyadelphia Polyandria;* natural order, *Myrtaceæ.* Generic character: calyx four-toothed, persisting; corolla of four petals; phalanges of the stamens elongated, coloured; anthers oblong and erect; half of the filaments sterile; capsule three-celled, many-seeded, and intimately connected with the thickened tube of the calyx. These are green-house plants and propagated by cuttings.

CALOTIS (R. Brown). A green-house perennial herb from New Holland, belonging to the natural order *Compositæ.*

CALOTROPIS (R. Brown). A genus of two species, natives of India. Linnæan class and order, *Pentandria Digynia*; natural order, *Asclepiadeæ.* Generic character: corolla somewhat bell-shaped; issuing from a kind of bag at the base; crown and limbs approaching and pressed together, revolute at the base, points two-toothed; follicles smooth. This plant has been long known in British collections as the *Asclepias gigantea.* It is one of the commonest jungle plants on the coast of Coromandel, and met with growing in loose sand.

CALTROPS. This is the genus *Tribulus* of Tournefort, and has its trivial name from its thorny seeds, which resemble those instruments of war thrown in the way of cavalry to lame the feet of the horses. One of the species is a common weed in the East Indies, and most annoying to the unshod natives. Linnæan class and order, *Decandria Monogynia;* natural order, *Zygophylleæ.* Generic character: calyx of five sepals; petals of the corolla spreading; stamens alternately inserted in the base of the petals, the others below the germen; filaments filiform; anthers oval, opening longitudinally; style thick, conical; stigma five-ribbed; seed-vessel or berries five, tuberculed or spinous on the outside, containing each one seed.

CALYCANTHEÆ. Carolina allspice family. A natural order of dicotyledonous plants, containing two genera and eight species. It is allied to the *Rosaceæ, Pomaceæ,* and *Myrtaceæ,* and is distinguished from these orders by its imbricated sepals, and its anthers being turned outwards.

The characters of the order are,—sepals and petals confounded, imbricated, and combined into a fleshy tube; stamens indefinite, inserted into a fleshy rim at the mouth of the tube, the inner ones sterile; anthers adnate, turned outwards; ovaries several, simple, one-celled, with one terminal style; nuts enclosed in the fleshy tube of the calyx, one-seeded; seed without albumen.

The plants of this order are beautiful hardy shrubs with square stems, opposite, rough leaves, and axillary yellowish or lurid purple flowers. They are found in North America and Japan.

Their wood presents a singular structure, which may be said to combine both the exogenous and endogenous mode of growth. Besides the usual deposit of concentric circles round the central pith, there are also four imperfect centres of deposition on the outside next the bark.

The Calycantheæ are propagated by cuttings and layers. Their general properties are aromatic, and their flowers are highly odoriferous.

The genera of the order are *Calycanthus* and *Chimonanthus.*

The *Chimonanthus fragrans* flowers early in spring, and diffuses a most delightful odour.

CALYCANTHUS (Linnæus). A genus of hardy shrubs, natives of America, and which form one of the orders of the natural system. Linnæan class and order, *Icosandria Polygynia;* natural order, *Calycantheæ.* Generic character: calyx a much divided coloured perianthemum; corolla none; stamens numerous, inserted into the neck of the calyx; anthers oblong, two-celled, adnate; styles many, compressed; stigmas glandular. Some of these plants have been long in our shrubberies, and are propagated by layers.

CALYCEREÆ. A natural order of dicotyledonous plants, containing three genera, and only a few species. It is allied to *Compositæ* and *Dipsaceæ,* differing from the former in its pendulous albuminous seeds and superior radicle, and from the latter in its united filaments, and partly distinct anthers.

The characters of the order are,—tube of the calyx adnate with the ovary, limb of five unequal segments; corolla funnel-shaped, with a long slender tube, and five segments, each of which has three principal veins; stamens five, monadelphous; anthers combined by their lower half into a cylinder; ovary one-celled; ovule pendulous; style simple, smooth; stigma capitate; fruit an indehiscent pericarp; seed solitary, sessile.

The plants of this small and curious order are herbs with alternate leaves, and terminal or axillary flowers collected into heads. They are natives of South America, and are not remarkable for their beauty. Their properties are not known. The genera of the order are *Calycera, Acicarpha,* and *Boopis.*

CALYCIFLORÆ is the second sub-class of the first sub-division (*Dichlamydeæ*), of the first class (*Dicotyledoneæ*) of the natural system. It contains all the polypetalous plants, which have the petals inserted in the calyx. This sub-class comprises one thousand one hundred and forty-nine genera, and eleven thousand four hundred and thirty-five species, arranged in sixty orders.

CALYCOTOME. The title of one of the tribes of the genus *Cytisus.*

CALYPSO (Salisbury). A genus containing two species of North American orchideous plants. Linnæan class and order, *Gynandria Decandria;* natural order, *Orchideæ.* Generic character: sepals of the calyx distinct, four turned down, and five erect; labellum ovally-oblong, slipper-shaped, with a spur; column jointed; pollen in two masses. This plant has borne several names since it was first discovered. Linnæus called it a *Cypripedeum;* Willdenow named it *Limodorum,* and others *Orchideum.* Salisbury's name is most generally adopted.

CALYPTRANTHES (Swartz). A genus of tropical trees, found in both Indies. Linnæan class and order, *Icosandria Monogynia;* natural order, *Myrtaceæ.* Generic character: calyx with an obovate tube, limb entire, and deciduous like a cap; stamens joined to the tube of the calyx; filaments capillary; anthers roundish, two-celled; style simple; berry one-celled, with strong scented seeds. This genus are handsome trees, and some of them furnish good timber.

CALYPTRION (Gingina). A genus of two

species of tropical plants, one a climber from Africa, the other an under-shrub from Brazil, The flowers resemble those of violets; and Aublet, a French botanist, named the African one, *Viola Hybanthus*. The genus is ranked in the order *Violarieæ*.

CALYSTIGIA (R. Brown). A new genus, separated from the genus *Convolvulus* of Linnæus. See Bindweed.

CALYTRIX (Labillardiere). A genus of New Holland ornamental shrubs, belonging to the Linnæan class and order *Icosandria Monogynia*, and of the order *Myrtaceæ* of the natural system. Generic character: calyx furnished with two bractæ at the base, tube cylindrical, elongated, limb in five oval divisions, terminated by bristles; corolla of five petals, inserted in the calyx; stamens attached to the throat of the calyx; filaments awl-shaped; anthers roundish; style filiform; capsule one-seeded, not opening; seed somewhat cylindrically club-shaped. All the plants of this natural order (*Myrtaceæ*) are in one respect or other estimable. It contains some of our finest fruits, and many of our most beautiful flowers.

CALYX is the name given by botanists to the outer coat or covering of flowers. It is the cup-like member which includes all the others. It is generally green, but sometimes coloured, sometimes entire, but much more frequently divided into parts called sepals, which remain erect or are reflexed. The calyx is said to be inferior if seated below the germen, and superior if seated on the side, or on the top of it: in the two last cases it is usually persisting, its base being swollen into a fruit, or seed-vessel. In some instances, the calyx is entirely wanting, or appearing only as a slightly raised rim. In the second subdivision of the class, *Dicotyledoneæ*, the calyx and corolla are united, in which case it assumes the colour of the latter. This member of the flower affords many pertinent distinctions in descriptive botany, and is usually the first which is noticed.

CAMEL (Cameleus, or rather Camelidæ, the camel family). A group of ruminant animals, partaking in part of the characters of the *Pachydermatous*, or thick-skinned animals, and also of those of the other ruminantia; but having characters which are peculiarly their own, and in consequence of which they form a very well-defined, and also a remarkable group.

There are two divisions of them, the one found only in the more arid portions of the Eastern continent, and the other only in those of the Western,—the former being entirely, and the latter chiefly, in a state of domestication. These two divisions have characters sufficiently distinct for warranting the arrangement of them as separate genera in the system; but we shall save time and also render the account of them more clear, by including both in one article, and stating first those characters which are common to both genera.

The most remarkable of these characters is that of the feeding apparatus, more especially of the teeth: these are as much tearing teeth as those of the carnivorous animals, but they are tearing teeth of a different description; those in the anterior part of the mouth are not formed for wounding, neither are the false grinders suited for bruising flesh; they and the incisors and canines are all adapted for tearing vegetable matter of harder texture than that on which the rest of the ruminantia feed; though, like these, they subsist entirely upon vegetable matter. This structure of the teeth will, upon examination, be found the very best adapted for enabling them to feed upon the hard and prickly plants which, in the deserts, form at all times the principal, and at some times the only vegetation.

The characters and structure of the several families which form the order Ruminantia, can be better explained in their resemblances and contrasts to each other, in a general article upon the order, than in detached notices of each family; but still it may not be amiss here to state that the incisive teeth of those ruminants which browse upon grass, or other soft vegetable matter, are in the lower jaw only; that they are chisel-shaped, ranged in an even curve, and act against a callosity, or hard cartilaginous surface on the upper jaw. Teeth thus formed are not adapted for biting, as those of the last pachydermatous animals, the horse tribe (*equiænide*), all of which have six incisive teeth in each jaw acting against each other, and though they are not adapted for tearing, and have not the sharp nipper structure of the teeth of rodentia, as in the hare for instance, they give a very strong dividing bite; but the animals which have them, have little or no lateral grinding motion of the jaws, and thus their food is not returned to the mouth to be chewed, as in the ruminant animals. In the browsing ruminantia, on the other hand, the grass is brought to the callosity on the upper jaw by a circular sweeping motion of the tongue, and then, pressing the incisors of the lower jaw against the food so brought, they divide it, partly by the pressure, and partly by a twitch of the head.

The camel family have the mouth of a character intermediate between these, but differing in many respects from both. Their teeth vary in the two genera of which the group is composed, but they all have three, or, strictly speaking, four kinds of teeth; namely, two incisors in the upper jaw and six in the under, in all the species; two canines in the upper jaw in all the species, and two in the under jaw in the camels only; two false grinders in the upper jaw of all the species, and two in the under jaw of the true camels; and five grinders in each jaw of all the species; making thirty-six teeth in the true camels, and thirty-two in the rest.

They all have the lateral or grinding motion of the jaws, by means of which the food is reduced to a sort of pulpy mass, as it is brought up from the "hood" in rumination, previous to being carried to the true or digestive stomachs; thus these animals have a double operation in feeding as compared with most of the other mammalia: the first being merely the reception of the food into a portion of the stomach which answers merely as a receptacle or magazine, just as the craw does in gizzard birds. They can therefore take a larger quantity of food in the same time than those animals which do not ruminate, but they have afterwards to chew it; and this operation is carried on when they are in a state of repose. A particular account of the ruminating stomach, and the process of rumination, will be found in the article Ruminantia, so that we shall only notice here an error into which most authors have fallen, in treating of the stomach of the camel. It has been said that camels take in so large a quantity of water into their stomachs, and contrive by means, the explanation of which has never been attempted, to keep it so cool, that when travellers who use camels in the deserts, are reduced to extremities for water, they kill the animals and thus obtain a supply. It is somewhat singular that this opinion should have been held, or at least received by simple transmission from one to another, by even those whom we must suppose to have been acquainted with the structure and economy of the animals, at least so far as to be able to ascertain whether so curious a fact—a fact so perfectly anomalous—was or was not possible. Now, it would not be very easy to see how water could by possibility be kept cold, in any part of the body of a warm-blooded animal, even in Lapland, and much less in those burning deserts in which camels are used as beasts of burden. Farther, if even this impossibility were got over, or if it were admitted that the water were of the same temperature as the body of the animal in which it was contained, it is not easily seen either how it could get there, or of what possible use it could be to the animal; for though Buffon and other describers of that class, have said that the hump or humps on the backs of camels are badges of their enslavement in a domestic state, and do not belong to them in free nature, yet, not even they have gone the length of saying that camels have, in consequence of their enslavement, been taught to carry this supply of water for their masters.

In the first place, the supply of water was said to be found in that which answers to the second stomach, that is, to the hood or honeycomb—that portion of the digestive apparatus which is reticulated or formed into cells; and it is probably on account of the larger size of the cells in the camels, than in those other genera with which we are more familiar, that the mistake has been made. But when we consider the general use of the reticulated portion of the stomach in all those animals of the order with which we are acquainted (and as they form a large portion of our food, we are much better acquainted with their structure and functions than those of any other animals), we find that a reservoir for water is not one of its uses. The solid or dry food which is received into the paunch or first stomach of the animal, is carried from that to the second, or reticulated part, which rolls it into small lumps or pellets, which are returned one by one to the mouth in order to be chewed, and they are again swallowed, and go directly to the third stomach, or foliated portion, and thence to the fourth or true gastric stomach. The general action of the reticulated part is therefore to form the food of the animal into pellets, and return those pellets to the mouth; and, in the same order of animals, the same general organ, however it may vary in different genera or different species, always has the same general use. If this were not the case there could not be any useful arrangement of animals, as the known would be no guide whatever to the unknown.

Well, let us suppose that this second stomach, or hood, is distended with water to the amount stated in the accounts and then let us consider, in the second place, whether the animal could by possibility ruminate, or receive any nourishment whatever, retaining the water in that viscus. Is it not evident that grass or leaves, or other vegetable matters, could not be formed into pellets in a bag full of water; but only by means of an apparatus that could divide its comparative dry contents into small portions, by bringing its sides in contact with them? It is unnecessary to answer this question by any lengthened argument, for to any one who reflects for a single moment, the perfect improbability of ruminating, and at the same time having any quantity of water whatever in the second stomach must appear. The water would equally prevent both functions of the organ—the formation of the pellets, and the returning of them into the mouth; and without this, food in the paunch or first stomach would be of no use whatever, because that stomach can neither digest the food nor carry it to the places in which it is digested. After the food is chewed it is returned to the third stomach, without passing into the first or second; and at this stage of the process, and not before, the water which the animal drinks is mixed with it. We have seen already that the second stomach could not act if there were water there, and when the food of the animal is green vegetable matter, water, even in very small quantity, in the first stomach, is attended with very serious consequences, as it ferments, and the paunch is so distended by the gaseous evolution that the animal is in danger of suffocation, or even of bursting.

Thus it is evident, that the third stomach, the one in which digestion begins, is the first one that receives the drink of ruminant animals, and that water could not be taken into the others without suspending the whole digestive functions as long as it remained there. This must have been known, or at least might have been known, from the time that mankind first began to observe, or, at all events, to kill sheep and cattle for food. It is, therefore, passing strange, that the story of water in the stomach of the camel should not have been exposed and exploded upon physiological grounds as early as anything was written upon the subject; and that it should still be continued in all the popular books, is a melancholy proof of how badly those who pretend to school us in natural history are qualified for the task.

There is a small quantity of limpid fluid in the abdomen of most or all ruminating animals; but this fluid is not water, neither is it contained in any of the digestive organs, nor can it be taken into these. It is an animal secretion, and the chief use of it seems to be to lubricate the very large and complicated intestines, and also to serve as a yielding support between them and the parietes of the abdomen.

This fluid is, in all the ruminantia, when in a healthy state, wholesome and pleasant to the taste; and it may be possible that travellers, when their camels drop down dead in the deserts, may sometimes moisten their parched throats with this fluid; but it is by no means likely that a camel is, in any one instance, killed for the sake of obtaining it. The camel, though a clumsy animal, according to our notions of animal beauty, is a very valuable, and consequently a very highly esteemed animal in those parched countries where it is used for carrying men or luggage. It is strong, though not swift; it is sure-footed; and it can endure fatigue and bear privations more than any other animal.

It can also subsist upon harder food than any other beast of burden: and its size, and the length of its neck, enable it to reach the branches of shrubs and small trees which are above the reach of the ass, which is the animal that comes nearest to the camel in the coarseness of its food. For all these reasons, the camel is most deservedly a favourite with those who use it, and is in no case the subject of wanton destruction.

No doubt, many camels perish in the deserts, but, as they can subsist a considerable time upon little food, and long without water, they generally perish with fatigue in crossing the deserts. Captain Bourchier, R.N., who was shipwrecked in the Red Sea in the end of 1833, and reached Suakin as a landing-place, and thence across the south of the desert to Berber, and thence down the Nile, and across the northern desert from Abu Hamet to Kroosko, travelled on camels the whole distance; and, in the northern deserts especially, where the days were hot and the nights cold, some of the camels employed by his party were left to perish; and he observed the skeletons of many more which had previously been left to feed the vultures in the wilderness. The Captain had opportunities of directly ascertaining whether there was any water in the second stomach of those camels, but he did not find any, or even the smallest indication that there had been any. On the contrary, the camel-drivers ridiculed the idea as one which could not be entertained by any one in the least acquainted with camels. When those animals are so much exhausted as to be unable to proceed farther, either with their burdens or without them, they are sometimes not even killed, but left to linger in the desert; and in order to hasten their death, their fore-legs are tied close together, to prevent them from crawling about and procuring a scanty supply of the hard and acrid plants, to protract the period of their suffering; for, as to hope recovery for any exhausted creature that may be left in those dismal places, there is none. But Captain Bourchier describes the cries of those abandoned camels, when the caravans leave them, as being among the most heart-piercing that are uttered by any animal; and this, coupled with the feeling, that without the camel man could not make his way across those deserts, but, if he once got into them, must remain there and perish, makes the death of a camel in those places one of the melancholy sights that can well be imagined—a sight that could be ill requited by the small quantity of fluid which is contained in the abdomen of the animal.

In remarking on this error, we have anticipated some of the observations which properly belong to the true camels, as distinguished from the other members of the group, but what has been here anticipated will save so much description afterwards; and we now proceed to the more particular information.

Camels (*Camelus*). There are two species of this genus, both, as has been said inhabitants of the Eastern continent, but neither of them at present exists, except in a state of domestication. But there have been reports of wild ones in different parts, both in southern Asia and central Africa, but it does not appear that any of these accounts rest on a sure or even a satisfactory foundation. The only places where camels could be looked for as free animals, living and breeding in wild nature, are the margins of those deserts, in crossing which they are employed as beasts of burden; and the only ruminant animals which are found there in a wild state are different species of antelopes. There has been much change in those countries however; and though the Arab, in the same identical race, has probably pitched his tent in them from the earliest period of human history, yet other nations have risen and fallen in succession, sometimes invading the Arab in the wilderness, and sometimes being invaded by them in return. Thus we may naturally suppose that, as has been the case with some of the domesticated oxen (see the article Bos), stray camels may sometimes have been left running wild, and may have bred in the wild state for a few generations. It does not however appear, that they have been capable of continuing their race, even in this way, for any length of time, and it is certain that they have never multiplied in this manner to any extent. Thus we must regard them in a zoological point of view as domesticated animals only, and as such we shall accordingly describe them.

But, as already noticed, the great distinguishing character is the teeth; and it will save verbal description of their appearance, to refer to Landseer's very spirited and accurate representation of the Arabian camel, or dromedary, in the plate "camels," and to a wood-cut after the same artist in the sequel of this article, for the Bactrian camel, the number of teeth, under different sorts, have been already mentioned. There are five grinders in both sides of each jaw, which have the same furrowed surface, arising from alternate laminæ of bone and enamel, as the grinding teeth of the other ruminating animals. In advance of these there are two false grinders in each jaw, which stand apart from the rest, and are subconical, and a little bent backwards. In front of these there are two strong canines, and in the upper jaw two front teeth which have also the form of canines; and these scattered teeth lock into the intervals of those of the lower jaw, and give the mouth, while the lips are opened, a very ragged and formidable appearance. Nor is the bite of the animal when enraged, (and the male is very apt to be so during the rutting season,) a very simple or very pleasant matter; for instances are mentioned in which an enraged camel has wrenched off a man's arm at one bite. These formidable teeth are not, however, intended by nature for assailing any other animal, their grand purpose is to wrench up the hard plants, and tear off the branches of trees which grow in those wild countries; and the length, and power of motion in the neck, give the animal great force in this respect; and, though the fore teeth of the camel are not adapted for wounding, or the first grinders for bruising, like those of beasts of prey, yet as they have to tear asunder very tough substances, the hold which they take is very firm, and the wrench which they give in order to separate that which they take hold of, is very powerful. The general form of their extremities will be seen in the figures. Their hind legs are considerably longer than their fore ones, though all four are long in comparison with the body of the animal, and the neck is proportionably long, in order that it may reach the ground, as well as those branches that are above them. Indeed, from the length and flexibility of the neck, the mouth commands a very considerable circle, of which the axis of the body is the centre.

As is the case in all ruminating animals the metatarsal and metacarpal portions of the extremities consist of only a single bone each; and the feet consist of two toes, free only at a portion of the points, and having a sole extending from the heel forward for the greater part of the foot, and consisting of a callous though not perfectly hard substance, intermediate between the pads on the feet of beasts of prey and horn. The extremities of the toes are fortified by flat nails, which have a very slight resemblance to proper hoofs. The joints of the legs are also armed with callosities, which prevent them from being injured when the animal kneels on the bare and hot sand; and there is a similar callosity on the sternum, or breast bone, which prevents injury to that part when it comes in contact with the hard and hot ground. There are no clavicles to the fore legs; and all the legs are articulated for motion parallel to the mesial plane, so that the animal cannot climb, or grasp between its feet. It has, however, very considerable action of the legs in that plane in which they do act; and it can, in consequence, defend itself very effectually against jackalls and hyænas, which are the principal beasts of prey in its localities, both by striking out with the forefeet and kicking with the hind ones,—the first of which motions is not so extensively possessed by any other ruminating animal. In the use of its long legs upon ordinary occasions the camel, according to our common notions of grace in walking, manages its long legs a little clumsily. When rising (and it is made to kneel when mounted or loaded), it rises first on the hind legs, and supports itself whilst doing so on the callosities on the fore knees or the sternum; and while it is doing this, the rider if he has not some knowledge of camel-riding, is very apt to be bumped across the ears with the load on the top of him. In walking, too, the rate of which on the ordinary march is about three miles an hour, the camel has a very jolting motion; and it requires practice before the rider can so accommodate himself to the riding as to have anything like an easy seat; but after he once acquires the habit of moving in concert with his beast, his seat is very secure, and by no means an unpleasant one.

As may be seen by the figures, the whole appearance of the camel is ragged. Its abdomen is large, and so much drawn in at the flanks, as to give it an appearance of weakness and constriction there, which it does not in reality possess, for the bones of the hind legs are, by this means, left much more free for motion than in animals which have a more firm and full appearance at that part. The neck is long and bent; the eyes are large and dull; and the lips are projecting, but thin and flap-like, the upper one being divided, and the two lobes prehensile and capable of separate motion. These moveable lobes of the lip are of considerable service to the animal. They serve as organs of touch, and also for compressing any substance, or conveying it into the mouth.

The nostrils are in the form of slits, which the animal can open and shut at pleasure; a species of action which is of great service to it when the wind blows strongly and loaded with drifting sand, as it often is in these deserts. The form of the enlarged sole of the foot, which has been already mentioned, is very convenient for marching on the loose sand, as it has the shape of an oval cushion, which is less apt to sink than any other form. The height, too, to which the feet are lifted, and which occasions the bumping motion, is of great advantage in walking over the loose sand; and it is worthy of remark that the ostrich, which is an inhabitant of similar places, has the feet of an analogous structure, and lifts them in a similar manner.

One of the most singular external characters of the camel, is the hump on the back, which is double in the Bactrian camel, and single in the Arabian one or dromedary; this hump consists of the same kind of substance which is found in humps upon some of the genus bos, in some temperate, but more especially in warm regions, as in the Braminy bulls of India, both in the larger and smaller varieties. It is an accumulation of a peculiar species of fat, which is not liable to be melted, or very much acted upon by the great heat to which the animal is exposed. It consists chiefly of *stearine*, or hard fat, which is not reduceable to liquid oil at any temperature to which the animal can be naturally exposed; and it is not a deformity produced by servitude, as has been foolishly said, neither is it in itself of any use in the economy of the animal. It is a store of nourishment, most wisely provided by nature against the day of want, to which the camel in a wild state would be often exposed, and from which he is not entirely exempted in a state of domestication; and a camel can exist for a considerable time upon its own hump without any other food, nor does it die of want until that hump is entirely absorbed, and applied to the general nourishment of the whole system.

Animals which exist chiefly upon vegetable matter, and which are subject to seasonal vicissitudes in their supply of food, all make accumulations of fat on some part of their bodies, and have some provision or other, against the season in which their outward supply of food fails; and their tendency to do this is exactly in proportion to the need they have for it, considering the average in the seasons of those places in which they inhabit. The parts of the body in which this accumulation is made, and the consistency of the accumulated substance, are both very important points in the geography of animals, which is one of the most interesting departments of their whole history. If the animal winters in cold latitudes, as is the case with the bears, then the accumulation of fat is generally distributed over the surface; and it is of a soft and oily nature, or what is termed lard. If, on the other hand, the animal inhabits the very warm latitudes, where the season of want is one of heat and drought, the accumulation of fat, as in the hump of the camel, contains a maximum of crystallisable fat, and is accumulated upon some particular part of the body, generally that part in which it can be carried with least inconvenience to the animal, and least interruption to any of its working structures. In the intermediate latitudes, where there is a supply of vegetable food all the year round, the distribution of fat is more general through the body of the animal, both externally and internally,—accumulating on the kidneys, on the mesentery, and often on the surfaces of the muscles, and even upon those of the bundles of fibres of which the muscles are made up; but in animals which do not accumulate fat on any particular part of the body, as many do in a hump, a dewlap, on the rump, or even on the tail as is the case of some species of sheep, then the accumulation of fat is always more internal as we advance into warmer latitudes. Thus the sheep and pigs of France never, by any feeding, acquire the same external plumpness as those of England; and the difference is so great, that those of some places of France, even when in the very best condition to which they can be brought, would hardly be marketable in this country; but when they are opened they are found to contain more fat internally than ours do.

If we consider the ruminating animals only, the range of which in latitude may be considered as extending from the reindeer to the camel, we have a regular gradation in the kind of fat, which is no bad indication of the native localities of the animals; it being understood that the genera which are found nearest the pole keep more and more to the mountains, as they extend nearer and nearer to the equator; and that the genera which are first met with in the savannahs, in the northern parts of the temperate latitudes, follow the lines of the rivers, and the margins of the forests. Among these, the accumulated fat of the deer tribe is the softest; then follows that of the ox, afterwards the sheep, and lastly the camel; but some species of the intermediate groups accumulate crystallised, or at all events curdy fat, according to their nature, and that of the places which they frequent.

The antelopes, which are in general light and fleet animals, and thus much more capable of shifting seasonally after their food, have not such a tendency to the accumulation of fat; and the same might be said of the kangaroos of Australia, which, though not ruminating animals are vegetable feeders, and the only native animals which supply the place of the ruminantia in that part of the world.

The only other general characters which it is necessary to mention in the true camels are, that the females go twelve months with young, produce only one at a time, which is dropped with the rudiment of a hump and with the eyes open, but it has not the callosities on the sternum or the joints of the legs; the female has four teats, and continues to suckle her young one for twelve months, as it is a considerable time in being able to support itself by browsing. As already hinted at, the males become very fierce during the rutting season, and they undergo certain other changes which are peculiar. The humps in a great measure disappear, owing in all probability to the animals then ceasing to feed; they become less strong than at other times; their eye sare inflamed, they discharge a fœtid liquor from the glandular openings on the back part of the head; they foam at the mouth, and occasionally at least protrude the uvula between the teeth, as if it were an inflated bag of a deep red colour.

There is little difference between the Bactrian and the Arabian species, other than that the former is proportionably longer in the body and lower on the legs, and has two humps. It is generally understood that the two breed together, but the fact as to whether the progeny will again breed with each other, and thus establish a specific identity, or whether they be mules, which, like those between the horse and ass, will breed back to the pure blood of either parent, but not with each other, is not yet settled.

The Arabian Camel (*Camelus Dromedarius*) may be considered as the camel *par excellence*; as it is the one which is best known and employed on the most difficult, and therefore the most important journeys. To the Arab in the desert, especially those parts of it in which neither sheep nor goats can be kept; the camel is an exceedingly valuable animal, and in this respect approaches nearer to the ox, where kept for draught and burden, as well as for food, than perhaps any other animal. The flesh of the camel is eaten; and the milk is applied to all the common domestic purposes. Their hair is manufactured into clothing, and also covering for tents. The hide, which is very thick and strong, is used for making sandals, saddles, pitchers, shields and various other articles. The owner, with his family, and all their little appointments, are carried from place to place on the backs of the camels. When the camel kneels down for repose during the night, his side forms a pillow; and when the sand drives before the storm in the desert, the rider takes shelter in the lee of the kneeling camel. Upon occasion, the camels are sometimes ranged round the encampment, forming both a shelter, and at least a temporary means of defence in cases of attack during the night; and those countries which are separated from each other by wide extents of desert, could have no communication with each other but by means of the camel. The camel and the desert thus appear to be made for each other; and though the appellation of "the Ship of the Desert" no doubt partakes of little of the high hyperbole of eastern speech, yet that animal is the only ship by means of which the desert can be navigated either with certainty or with safety.

An Arabian camel can carry a load of between 700 and 800 pounds, and travel with it at the rate of about two miles and a half in the hour. When less heavily laden it can travel faster, though not above three miles in the hour; and in the deserts it is not customary to load the animals very heavily, or drive them more than about eight hours in the day. Though the eye of the camel is heavy, his senses, especially that of smelling, are very acute: and though there is some trouble as well as some skill necessary in breaking a young camel, yet when properly broken they are docile; with proper treatment they last much longer than the horse, being serviceable to the age of forty or forty-five years; but in India, where they are heavily laden, and not so well treated as in the countries to the westward, they do not last above half that time.

Camels have been partially introduced into some of the warmer parts of the South of Europe; but they are not properly at home any where except on surfaces of dry sand or mud; on hard ground their feet get beaten, on rocks they get cut, and on both kinds of surfaces the planting of the feet shakes them violently, and they run some risk of dislocating the joints of their legs; their manner of walking, and also the convex form of the soles of their feet, render a surface which yields partially to the tread necessary to their walking with comfort; and when one sees a camel led about for show in paved streets, the animal seems to walk in great pain, and looks sickly from the constant jolting of its weighty body, and the tendency which its feet have to slide, especially if the pavement is wet, or glazed by the traffic of carriages in dry weather.

Camels are sometimes used in war, and small pieces of ordnance are occasionally mounted on their backs; but the principal use of them are for more pacific purposes. When a horde of those nomadic tribes, which depend much on their camels, remain stationary in any locality, they let their camels pasture together in considerable flocks; but the males and females are kept in separate pastures, by which means they all remain tractable, except during the rutting season, and then the males often fight desperately with each other by biting, striking, and kicking, in the course of which they endeavour to throw each other down, and the one which goes to the ground is sure to be trampled under foot by the other. They are even exhibited in combat among the coarse spectacles of the place. This is not, however, very common.

As is the case among horses, and indeed among all animals which have been long in a state of domestication, there appear to be considerable "differences of blood" among camels. Those which are used in common caravan travelling, with heavy loads, and at a slow rate, bear nearly the same relation to the smaller, lighter, and fleeter breeds, which are used in reconnoitering or on swift journeys, that our heavy dray and cart horses bear to roadsters, hunters, and racers. It is to this small and fleet breed that the name dromedary, or *mahairy*, properly applies. By means of these, no doubt with relays at the different stages, a journey at the rate of more than four miles an hour may be kept up night and day for several days. It has sometimes been alleged that this difference of speed in different individuals should be considered as arising from a difference of species, and there have not been wanting attempts to show that these different species originated in different parts of the country, but there is little reason to suppose that either the one or the other of those suppositions have the slightest foundation in truth; though there is no doubt that camels, like all other animals, are affected by differences of climate, pasture, and treatment. And, as the swifter ones are said to be more in the hands of the wandering Bedouins than of those who have comparatively fixed abodes, it is highly probable that the farther into the desert, the camel is the fleeter, and the smaller in size. This accords with what is observed of animals in our own country; and as is the case with these, it seems to be in hardihood and power of endurance more than in absolutely greater speed, for a short time that the mahairies are superior to the larger camels which are employed to carry loads at slower rates and at shorter distances.

The Arabian camel is, in the largest breeds, about seven feet in height; but the smaller and swifter ones are lower. The legs are long and slender, and what are considered "clean made." It is very much drawn in at the flanks, but the abdomen is rather too large, and the length of the intestinal canal and size of the stomachs, rendered necessary by the coarse nature of the animal's food, require that it should be so. There is but one hump, which is nearly in the middle of the back, broad and rather flat in the upper part; and it does not waste so much in the rutting season as the hump of the Bactrian camel. Independently of the different breeds which are reared for different purposes in the domestic economy of those people who use camels, there are considerable differences arising from the characters of the countries in which they are bred. In this respect they follow the law of all domesticated animals which find their food in the fields; that is, the richer the pasture is the breed runs the larger, and the breed gradually diminishes as the pasture becomes bare and dry. So that if large camels are wanted in Arabia or in the African deserts, the breed has to be obtained, or kept up by periodical crossing, from Turkey; and on the other hand, if light and fleet camels are wanted in the richer places, they have to be obtained by means of the breeds of the deserts. Independently however of this, there appears to be some difference of size connected with difference of latitude, as they are smaller in proportion as they are bred in places nearer the equator. From this it has sometimes been argued that the Arabian camel is not a native of Arabia, but of Syria, and even the northern part of that country toward the mountains of Armenia; and that of the two species of camel, the one are natives of the country immediately to the south of those mountains which range from the Himalaya to the shores of the Archipelago, and that the others are natives of the northern slopes of the same mountains

That this mountain ridge is the natural boundary of the localities of the two species or varieties may readily be admitted, because the hair of the Bactrian camel follows the general law of that of all animals of Central Asia northward of the line of the Himalaya. Toward the winter it grows very long, as if to serve as a thatch against at least occasional snow storms; and when summer sets in, this winter coat of long hair is shed, so that during the summer, which is very hot and dry in those places, as compared with the winter, the animal is nearly naked. In the Arabian camel, on the other hand, there is no such seasonal change in the hair. No doubt it is longer in winter than in summer, and the coat is annually changed as well as that of the other; but the change is gradual in comparison, and the difference in the winter and summer appearance of the animal is not nearly so great. In this respect, however, there is a considerable difference between the camels of the northern and the southern parts of their range, or more strictly speaking, between those that inhabit countries which are subject to periodical rain and drought, and those which inhabit where the climate is habitually dry, and with the exception of difference of heat (which is not very great), the weather may be said to be nearly the same all the year round. This is very much the case on the borders of the western or rather the central deserts of Africa, and it is partially also the case in some of the northern parts of Arabia. These are the places where the smallest and fleetest camels are bred, and also where their hair is shortest and most uniform in length throughout the year.

There is thus a wonderful accommodation to climate in the camel, as well as in all the other ruminantia, which are so very serviceable to man in a domestic state; and from this we may infer that, in so far as its general health is concerned, the camel might in course of time be domesticated, and thrive in a domestic state, in any latitude, from Lapland to the equator. There is something very remarkable in this universal adaptation of those animals which are the most serviceable to the human race, so remarkable that it is impossible not to see that God has created those animals for a double purpose. First, for their general use in wild nature, in which they agree with all other natural productions; and secondly, in their peculiar use to man in all stages and degrees of civilisation. And we may remark that the very same law holds good in the vegetable kingdom. All those plants which are more eminently necessary for human food can, with proper management, be grown in perfection over a vast range of surface. Wheat, which is probably (though the fact is one which cannot be ascertained with certainty) a native of Northern Africa, can be profitably reared in the north of Scotland; and the potato, which is originally from Central America, forms a large proportion of the vegetable food even of Northern Europe, and is much better there than in any part of that continent of which it is a native.

Animals and vegetables which are not serviceable to man, or of which the possession partakes more of the character of a luxury than that of a necessary life, do not so readily accommodate themselves to different climates; and in order to have them in places which are not native to them, a good deal of art must be practised, and a good deal of expense incurred. But though the valuable animals accommodate themselves to different climates, there is still one part of their organisation which keeps them to that peculiar kind of surface on which food most nearly resembling that of their native places is to be found; and, as the camel is a native of very peculiar kinds of surface, the camel is a very remarkable instance of this. These animals use their feet only as organs of motion, and except in kicking or striking in their own defence, they use them for no other purpose; and, therefore, the structures of their feet keep them more to their proper localities than those of any other animals, as for instance, the buffalo to the swamp, the ox to the meadow, the sheep to the hill side, the goat to the rocks, and the camel to the desert. Therefore, though it is possible to rear any one of those animals over a very wide extent of latitude, there is still some one better fitted for every particular place then any of the others are; and thus, though nature has been exceedingly bountiful to man in the valuable qualities in those animals, the advantage is not given to him as an ignorant and indolent savage, but as a means of rational study and wholesome labour. Hence, every department of nature, as well as every difficulty and distress by which man is overtaken on his progress through life, impresses upon him the necessity of being intelligent and industrious—proclaims to him, in language not to be mistaken, that if he would avoid being wretched and miserable he must learn to know and to do, and continue steady in the practice of both, during the whole period of his life.

The Bactrian Camel (*Camelus Bactrianus*) can be very easily distinguished from the Arabian one, by comparing the annexed figure with that on the

plate "Camels." It will be seen that it has two humps, one over the shoulders and the other over the lumbar part of the spine. This, though lower on the legs, is altogether taller by about half a foot than the Arabian. It is also longer and stronger in the body, thicker in the legs, but not having the soles of the feet quite so large in proportion, or so convex on their surfaces. Thus it is better adapted for walking on hard surfaces than its southern neighbour. Still, however, it walks very badly upon rocks; and thus it is not a mountain animal any more than the other. The difference in the feet of the two species is, next to the difference in the coats already mentioned, one of the most characteristic distinctions between the two, and the difference in the length of the legs may be considered as a part of this character. The broad and rounded foot, the long leg, and the high lifting of the Arabian camel, together with the proportionally smaller weight of its body, adapt it in a peculiar manner for travelling upon loose sand; while the smaller and flatter foot, and the shorter and stouter leg, with the lower lifting in the Bactrian camel, adapt it better for walking on the surface of the ground, when dry and indurated, but not reduced to sand. The foot stands firmer, and the animal has less concussion when it walks, and thus, independently of its greater size and strength, this animal could carry a greater load than the other.

Now those two characters are in exact conformity with those of the deserts on different sides of that line, which has been described as separating the localities of the two species. From the absence of rain, and the continual heat of the day, in the southern deserts, the surface of the earth, even to the rock itself, is reduced to powder; but it is not washed, neither are those particles which would make a paste with water, either accumulated in such quantity as to form a paste, or supplied with so much water as would form them into one. The sand therefore remains loose on those deserts at all seasons of the year, and even where so much rain falls that their peculiar vegetation is produced; and that vegetation may be said to be wholly on the surface, very slow growing, and furnished with an *epidermis* so close and so little liable to be affected by changes of temperature, that the plants remain juicy, and even cool, in the burning heat of the desert. Those plants are generally saline, bitter, or have some principle in them too active for their being used as human food; but the few which can be so used are of a very refreshing character. We may mention, as an instance, the water-melon, which, in some places of the desert, where the surface is nothing but stones and sand, and where there is hardly another green thing to be seen, is sometimes met with as much as three feet in length, and the same in circumference; and though the sun is beating on it with the utmost intensity, it feels colder in the mouth than a prepared ice in the hottest of our summer days, so cold indeed, that those who are heated by travelling or otherwise, find caution necessary in indulging in this delicious treat which nature provides for man in the wilderness.

The northern desert, that of the Bactrian camel, is of a very different character. In the winter there is both rain and snow, and the rivers are not unfrequently so completely frozen over, that the people, and even the loaded camels, cross on the ice without danger. But the summer is very warm, and in many places vegetation wholly disappears from the surface. Still, the rains wash down the more soluble matter from the heights, and form it into a paste or mound on the levels; and there it is, in the summer, either a very fertile field, or a hardened surface, like our beaten paths in dry weather, according to circumstances.

A country so circumstanced is adapted to a very different vegetation from that which is found in the deserts southward. The portions of the plants above ground cannot endure the great difference which there is between the summer and the winter; and therefore it is in great part annual; or the plants have tuberous, or other strong and permanent roots. It is to this description of soil, when hardened, that the feet of the Bactrian camel are peculiarly adapted; and the adaptation is as perfect, and as clearly demonstrative of indescribable wisdom of design, as any other which occurs in nature.

Lamas (*Auchenia*). The animals which constitute this genus, or division of the camel family, differ considerably from those already described; but still they retain the general characters so perfectly as to belong to this family, and not to any other. What may be called the general system is the same in them as in the true camels; and all the differences between them are adaptations to difference of situation, and of the circumstances thence arising. They are all natives of South America, and of South America only; but they do not inhabit the plains. Their locality is on the different cordillera or ridges, which form the great chain of the Andes; and they inhabit those mountains as high as the commencement of the region of snow. From the great elevation of those mountains, and their lying nearly upon a meridian, there is perpetual snow upon the more lofty summits, through the whole length of the chain; and from various causes (some of which will be found noticed in the article America in this work,) they are subject to very violent storms.

The region of the Andes is so peculiar, and differs so much from those which are inhabited by the camels of the East, that no animal or other production of that region can be well understood, without some knowledge of the region itself. Indeed, no animal can be properly studied as a portion of the system of nature, the only point of view in which the study of it is any thing else than an idle amusement, unless the place of which it is a native, or for which it is best adapted, is studied along with it. This is generally omitted in works which profess to treat of natural history, and because it is so the public generally do not profit by those works, and therefore they do not care for them.

The slightest consideration will serve to convince any one of the necessity of studying the place along with the production. All the peculiarities of animals, or of nature's other productions, are adaptations of them to the places where they are naturally found, and consequently, without a knowledge of the situation, we can tell nothing of the use either of the different organs of an animal, or of that animal as a whole.

The Andes, as well as the eastern deserts, are in many places barren; but, in every other respect they are the reverse of each other. The eastern deserts are flat and monotonous, and unless when the winds drive the sands in the southern ones, or rain or snow falls in the northern ones, there is little natural action of any kind on them. They are not only in great part desolate of life, but they are deprived in a great measure of the action of dead nature. The Andes, on the other hand, are perhaps more diversified in their surface than any other portion of the earth of equal extent. Lofty peaks, frightful precipices, ravines cleft nearly mile deep, natural bridges, foaming torrents, thundering cascades, and every thing which is considered as forming part of the sublime of still life, is to be found there in the greatest abundance and the utmost perfection. Nor, independently altogether of vegetables and animals, is the working of nature any where, perhaps, upon so grand a scale as upon those wild mountains. Volcanoes are numerous, many of them rage incessantly, and Ætna would be but as a little hill by the side of the more lofty ones. Earthquakes are consequently numerous, and always fearful, and sometimes lamentable in their effects. Among the summits where man cannot comfortably inhabit, they rend and scatter the rocks with terrible destruction; and sometimes in the lower parts of the country they have, at a single vibration, shaken a city to pieces, and laid its ruins level with the earth. Nor is the action of the atmosphere less energetic. In the warmer parts, the lightning and thunder are awfully grand, and the rain falls so fast as to flood the ground in a few minutes; while on and near the summit, the snow storms darken the atmosphere, and drive with a fury unknown in any other part of the world, so that no other unsheltered animal can keep its footing, or even preserve its life.

In such a country, both animals and vegetables must be peculiar; and we may be prepared to expect very considerable differences between any race of animals, and those of the same race in the quiet deserts of the eastern world. This in part accounts for the little knowledge which we have of the animals under consideration, and there is another cause which has tended still further to limit our information, and also to render it inaccurate as far as it goes.

During the whole time that this part of the world was under the dominion of Spain, which was from our first knowledge of its existence down to a very recent period, the scientific world was studiously kept in ignorance of it; and even since it became independent, many parts have been too unsettled for enabling us to obtain any thing like correct information respecting a country so very extensive. Thus the little information which we possess respecting these animals refers more to single specimens out of their native country, than to their natural and proper habits within it.

Thus the Lamas were for some time studied as if they had formed part of the zoology of the eastern continent; and for a considerable time naturalists considered them as a kind of sheep, though in their true system they are camels. Even now, though there are living specimens at the gardens of the Zoological Society, and other places, the history of them is not yet perfect; though it may be said that they bear nearly the same relation to the true camels, that sheep and goats bear to oxen, or rather, perhaps, that some of them have more resemblance to the sheep, and others more to the goat. It is, however, to be understood, that the resemblance to these animals applies to the adaptation to the haunt only, and not to the system of the animal. There is however, one structural peculiarity in which the resemblance holds: the true camels have all four mammæ like the ox tribe, while the Lama division have two, like the sheep and goats.

Since the introduction of European cattle into South America, where they have thriven in a wild state to a degree quite unprecedented in any other part of the world, the lamas have become of comparatively small importance in a general point of view, though they are still much prized by the Indians and other mountaineers, in those wild places of the country which are not adapted for the pasturing of cattle. They are not now used as beasts of burden, except perhaps in some rare instances, where from the poverty and inaccessibility of the place, the colonists have left the Indians so much wealth as even a Lama; and it is probable that there are wild ones, especially of the smaller kinds, in many of the fastnesses of the Andes. The mule has in general, however, displaced them for carriage in the most difficult passages of the mountains, and the bullock and the horse in other places.

But, in earlier times, they were regarded as animals of great value; and it was probably as much owing to the possession of them as to any other cause, that the inhabitants of the Andes had made considerable advances in civilisation, while the inhabitants of the lower, and in as far as soil and climate are concerned, by far the richer parts of the country, remained in a state of confirmed and hopeless savageism. As beasts of burden, they are in some respects more stubborn than mules, and they have not either the strength or the sagacity of these animals; but still a full-grown lama will carry from a hundred to one hundred and fifty pounds weight for more than sixteen miles in a day, and over the most difficult passes, in so steady a manner as not to cast any part of the load. In this respect they are superior to the camel; they do not lift their feet so high, and therefore their march is not so dodging. When overloaded however, they become sullen, lie down under the load, and no good or bad treatment will make them get up till it is removed.

Their flesh is wholesome, their hide strong, firm, and useful for many purposes; and their hair, which is long and silky, and cast annually in the same manner as the fleece of the sheep, allowed to run unshorn, is of considerable value in the arts; so that though they are inferior to the domesticated ruminantia of the Eastern world in an economical point of view, they are still animals of no mean value; and it has been supposed that they might be introduced with considerable advantage into many parts of southern Africa, Australia, and other mountainous and dry districts of the Eastern world, which are too elevated for cattle, and too scanty of pasturage for sheep.

There are several species mentioned; and it is probable that the ones which have been longest in a state of domestication are, as is the case with all domesticated species of the order, very much broken into varieties, especially varieties of colour, upon differences of which, it is never safe to ground specific distinctions in this order of animals. There seems however, to be several species, though the differences between them are far from being clearly made out. Their history in their native country is very imperfect; and animals which are so obedient to climate, as those mountaineers which are produced in a climate so variable necessarily must be, are not to be safely judged of from the few specimens which are brought to Europe. We shall notice one or two of the principal ones.

The Lama (*Auchenia Glama*). These animals, as described by Humboldt and others who have visited their native country, and paid some attention to its native history as being wholly in a state of domestication, although, as they are not so attached to one another and to their homes as cattle and sheep, there are strays occasionally met with among the mountains, where it is possible that they may sometimes breed; but as, though sure-footed in the rocks, they are far from being fleet animals, they are soon recaptured. They are of all varieties of colour, from nearly a dull white to almost entirely black. They vary considerably in size; the largest being about five feet long in the body, and nearly four and a half at the shoulder. The neck has a bend downwards at its junction with the back; but it is long, and when the head is raised, the muscle is at least six feet from the ground. The head is thick in proportion to the length; the lips are thick, the tip of the ears (which are much longer in proportion than those of camels) are rather rounded. The legs are stout, the hoofs on the toes pointed, and capable of separating from each other so as to take a firm hold on the slightest inequality in the rock. Indeed the feet of these animals, unlike the round pads of the camel, are perhaps better adapted for keeping their footing on rocky places than those of any other family of ruminantia, except the goats. The back is straight, or rather bent down in the middle, and without any hump. This provision is not necessary in the mountains of South America, where, though there are considerable differences of seasons, these are nothing compared with those of the Eastern deserts. The lama is described as being a patient and good natured, though rather dull animal. Some notion of the general appearance may be obtained from a delineation of a black coloured one at the top of the plate "*Camels*;" but it is to be understood that this is not a distinct species, any more than the white, the rust-coloured, the dun, or the dull brown, the last of which is the most prevalent tint.

The Guanaco (*Auchia Hunaca*). It is very doubtful whether the animal described by this name be any thing else than mere varieties of the lama, produced by different pasture and climate, as they do not differ from each other so much as many of the breeds of sheep. These animals are chiefly from the southern parts of the Andes, where there is much more rain than in the parts near the equator. When full grown, the animal is said to be considerably larger, approaching in size to an ordinary horse; the hair on the upper part yellowish, that on the under part white; the head rounded; the ears straight; the muzzle pointed and of a black colour; and the tail short and sticking out like that of a deer. Altogether the animal is of softer expression, and appears as if better fed than the the lamas of the central Andes. It is also said to be much more abundant in the wild state, and indeed it is in that state that the greatest number are said to be met with, flocks of two or three hundred or even more being mentioned as occurring in the mountain valleys of the south, especially those in the interior of Araucania, between the western or more thickly inhabited part of that country, and the southern part of the Pampas. This is by no means improbable; indeed from the character of those countries southward of South America, and bordering on Patagonia, and probably in the interior of Patagonia itself, it is very likely that these ruminantia may be much more abundant, and thrive much better than they do in places near the equator. This part of America long lay under the brand of being one of the most dreary and inhospitable on the face of the earth; and there is no doubt that, immediately adjoining the strait of Magellan, it is rocky, rugged, and at certain seasons subject to violent storms. But Captain King, by whom it was lately explored, with more minute attention than it has been since the days of the earliest Spanish navigators (and it was their policy to conceal and not promulgate their discoveries), found many traces both of a tropical botany, and a tropical zoology; even along the very shore of the strait. We know also that great part of the Araucanian country westward is exceedingly fertile, though it is a country which has been but little explored; and as the Araucans kept up a continual war for their liberty with the Spaniards, and maintained their ground from the very earliest footing of the latter in Chili, it is not to be supposed they will, for many years to come, allow any Europeans, of whatever nation, very minutely to explore their country; and till that is done, we must be content with only a vague and traditionary history of probably several species or varieties of the lama family, some of which have been vaguely mentioned by Molina and others.

It is said that the animals, in this part of America, want some of the peculiar characters of the mountaineers: that, for instance, the pads of callous matter on the knees are much smaller, the hoofs much less adapted for holding on upon rocks; the hair longer and more silky, and the whole animal of a softer character.

The Alpaca (*Auchenia Alpaca*). A figure of this animal will be found in the plate already referred to, from which its general appearance can be more readily understood than from any written description. The general colour of the upper part is various shades of maroon brown, in some places inclining to black; and the upper part and breast are in general white, as also are the insides of the thighs. The hair along the back is very long and very silky, and almost as fine in the staple as that of the cashmere goat. It is an animal easily tamed, and quite harmless and docile; but when teased it assumes an attitude of defence, and blows and spits at its enemies. Several specimens have thriven well in Europe; and there is no doubt that this is an animal which might be introduced with advantage in many places. We are, however, not so much acquainted with its habits, as to know whether it would breed as freely and as profitably as the ruminantia of our part of the world.

Such are the bare outlines of what may be considered as one of the best defined natural families of ruminant animals, and also one of the most valuable in those places of the world to which their structure more peculiarly adapts them; and it is worthy of remark, that though the places of which they are native, are not the most tempting either for their spontaneous vegetation, or for cultivating, yet that, wherever they are found, mankind have, from the earliest accounts of them, possessed of at least some degree of civilisation.

CAMELEON, CAMELEONIDÆ, Cuvier's fifth family of Saurian reptiles, of which there is only one known genus, the Cameleon (*Chamæleo*). The name was applied by the Greeks, who were very well acquainted with those singular animals, though, how they came to call them "little lions," for that is the meaning of the name, cannot be very well made out, as there is not one point of resemblance. They have been celebrated from very remote antiquity for the power which they have popularly been said to have of changing their colours at pleasure, and especially of assuming the colour of the surface upon which they are placed, though much of what has been said upon this subject is, in all probability, exaggeration. Still they are very interesting, and at the same time very singular creatures, standing alone and peculiar among all the tribes of the order *Sauria*, numerous and varied in appearance as these are. The following is a brief outline of their general characters:—

The skin is granulated all over with little points of scaly matter, the interstices of which are, especially on the belly and throat, very elastic, and capable of distension, and when the skin is distended, the scaly points stand up; but the change of colour is in the intermediate parts of the skin, and not in the scales themselves. The body is compressed laterally, and with a toothed or notched ridge down the back. The tail is rounded and prehensile, and about the same length as the body. The head is short, and moderately thick, covered with smooth scales, some five-sided and some six-sided. The nose is generally blunt. The eyes are remarkably prominent, but they are covered by the common integument of the head, excepting a small hole over the pupil. They are capable of a good deal of motion, both in their own proper substance, and in the skin by which they are in great part covered. Each is capable of separate motion, and the two can move at the same time in opposite directions. Hence it is probable that the animal has a double sight, or can simultaneously perceive objects in two directions. But this is a point upon which it is impossible to obtain certain information, though it is probable that those insects which have *ocelli* in addition to their eyes, properly so called, have also a double sight. The teeth of the cameleon are three-lobed, the usual form of true insectivorous teeth. The tongue is fleshy, of a cylindrical form, and remarkably projectile, striking out to a great distance, and with so much celerity, that the motions of it are not easily observed. The tip of the tongue is covered with a very viscid and adhesive secretion, which is the only organ which the animal uses in the capture of its food. The motions of all the other parts of its body are slow; but so sharp and sure is the eye, and so rapid the shoot of the tongue, that it can kill insects with great certainty, and in quick succession, as they fly past it. In these respects it differs entirely from the *Agamis* of America, with which it has sometimes been confounded, as they catch their insect prey by agile motions of the whole body. Cameleons have no visible external ears, and the skin of the occiput is erected into a sort of pyramid. The feet have five toes each, which are divided into two fasciculi, the one containing three, and the other two—those which compose each fasciculus being united by membranes as far as the claws. They are terminated by moderately sharp claws; but the whole of the extremities are adapted rather for holding on with security than for rapid motions along those branches which these animals chiefly inhabit. The first pair of ribs are united with the sternum; the others are united to each other, and support the abdomen by an entire circle. The lungs are of very large size, and the animal can take in a vast quantity of air for its bulk, by means of which the elastic skin is extended till the granular scales are wide apart from each other, and the skin is nearly transparent. There is little doubt that this capacious breathing in the cameleon is the foundation of the very old mistake that the animal feeds on air. As already said, insects are its food, and it captures them in great numbers; and indeed, as the waste of the bodies of animals is generally very much in proportion to the quantity of respiration, the air which the cameleon takes into the lungs is a means of hunger, and not of nourishment. The tongue, the eyes, and the organs of respiration themselves, are, however, the only parts of the system in which there can be much waste, for the action of all the other parts is remarkably slow; and indeed, as the cameleon, from the mode in which it captures its prey, can be more successful by lying in wait in those places where insects pass on the wing, than in pursuit after them, rapid motion of the limbs would be of little use to it. But though the cameleons catch insects with great dexterity, those insects are generally of very small dimensions, so that many of them are necessary to make a full meal even for the "thin cameleon."

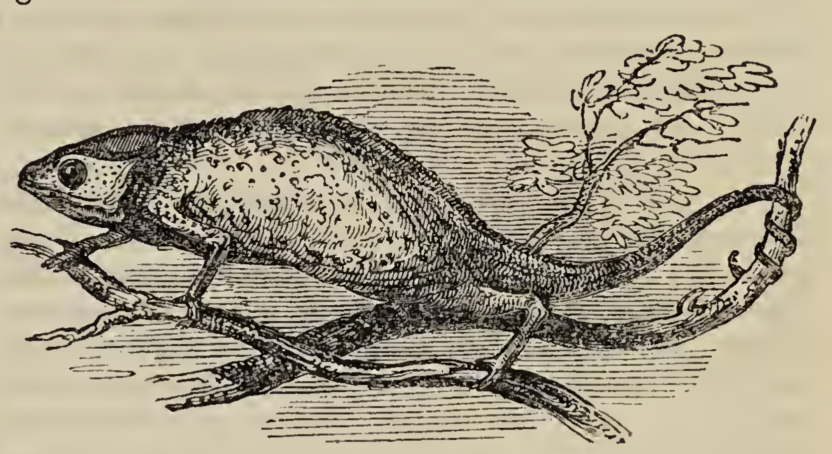
Cameleons may be regarded as almost exclusively tree animals, of very delicate nature, seldom on the ground, and perfectly innocuous, excepting to those small insects which they lime by means of the glutinous matter on the tongue. They are animals of warm climates only, and they are confined to the eastern continent, but in the hotter parts of that they are very generally distributed, being found in Africa, in India, and in the south of Spain. The structure of the feet, which bears some resemblance to that of zygodactylic birds, renders these animals but ill qualified for moving on the ground. Indeed, they are usually found on the branches of trees, with the body in a state of perfect repose; and they might be considered as dead, were it not for the rapid motion of the eyes, and the frequent darting out of the tongue; for, unless they are alarmed, or otherwise excited, they do not inflate the body by full respirations of air. In this state of repose, in which they can exist a considerable time without food, cameleons become a prey to the smaller species of the cat tribe; and in Spain, especially about the bay of Cadiz, where they are very plentiful, they are sought after by domestic cats with as much assiduity as small birds are by the same animals in Britain.

When they are at rest in the trees, their colour is white, with a trace of yellow; but when the skin is distended, and rendered thin and transparent by the inflation of the body, the colour of the blood, which is violet blue, appears through the whitish yellow of the skin, and gives the animal a green of various shades and intensities, according to the degree of excitement. The colour varies between white and blue, but never becomes exactly the one or the other; but there are some of the variations that appear almost black, and others in which it is brownish. There is not much iridescence in the colour of the cameleon, nor does it appear to change with age.

There are several species, of which, as they very much resemble each other in their manners, and do not differ much in other respects, very brief notices will suffice.

The Little Cameleon (*Chamæleo pumilus*), Smaller than the common cameleon. The colour light blue in a state of repose, but subject to variation from the same causes as in the other ones. It is found in southern Africa, Mauritius, and the adjacent islands. The occiputal crest is flattened backwards; the flanks, the tail, and the membranes of the toes, are thinly scattered with warty tubercles; on the throat there are numerous laminæ, finely denticulated in their margins, the number of which varies in different individuals, and the back is furnished with an acute slender crest.

The Common Cameleon (*Chamæleo vulgaris*). The general colour of this species, when in a tranquil state, is brownish grey, but the shade is said to vary in different countries. It has a spiny crest on the back and throat. The occiput rises in a four-sided pyramid, and there are prominent tubercles under the skin of the back. The scaly granulations on the skin are of equal size, and very closely set. The common cameleon rarely measures so much as two feet in length, and half of that is occupied by the tail. It is very plentiful in all the north of Africa, the south of Spain, and many parts of Europe. Some notion of its general form may be obtained from the figure.



The Senegal Cameleon (*Chamæleo Senegalensis*), is, as the name implies, found in western Africa, between the Senegal and Gambia. The general colour in a state of repose is pale yellowish ash, tinged with blackish toward the back; the crest is triangular; there is an acute crest on the back, and a serrated one on the belly.

The Striped Cameleon (*Chamæleo Zebra*) is rather larger than the common species, the crest on the occiput is more produced, and there is an elevated crest along the head; the throat has a row of tubercles along the middle; and the scaly granulations on the body are larger and more wide apart from each other than in most of the other species. The general colour, in a state of repose, is yellowish, but marked with black bars on the back, which descend toward the flanks, and are the occasion of the trivial name. It is a native of India, more especially of the lower and warmer parts of the valley of the Ganges.

The Spotted Cameleon (*Chamæleo pardalis*) is found in the Isle of France. The crest on the back of the head is flattened like that on the Senegal species, but there is a small border on the muzzle which projects beyond the opening of the mouth. The granulations are large and wide apart from each other, and the body is all over irregularly marked with round black spots, having white margins.

The Forked Cameleon (*Chamæleo bifurcus*). This species is a native of the Molucca islands. It has the muzzle divided into two parts, which are compressed laterally, and project equally. It is larger than most of the other species; the occiput is without a crest, or has only a small one; the granulations are uniform all over the body; the skin is marked with closely set blue spots; and on the lower part of each flank there is a double row of white ones.

Some other species are mentioned, and, as is the case with almost all the families of the Sauria, there are many undescribed specimens in cabinets. As the whole family are inhabitants of the woods, and as the woods of most foreign countries have been very imperfectly explored (the exploring of a wood is no easy matter); there may be many more which have hitherto escaped notice.

CAMELLIEÆ, or CAMELLIACEÆ, a natural order of dicotyledonous plants, containing only two genera and eight distinct species. It is closely allied to *Ternstrœmaceæ*, and by some authors is considered merely as a subdivision of the order, from which it differs only in its exalbuminous seed. The essential characters of that order are: sepals from five to nine, with an imbricated æstivation; petals five to nine, alternate with the sepals, often slightly cohering at the base; stamens indefinite; filaments filiform; anthers roundish; one ovary, with from three to six filiform styles; capsule three-celled and three-valved; seeds large, fixed to the central margin of the dissepiments; no albumen.

The plants of this order are smooth evergreen trees or shrubs, with showy axillary flowers. They are found in China, Japan, Cochin-China, or India. The leaves of many of the species are astringent and stimulating, and some possess slightly narcotic properties. The only genera of the order are *Camellia* and *Thea*, which are highly important as affording some of the most beautiful of our greenhouse plants, and as furnishing the *tea*, which is such a valuable article of commerce among the Chinese, and which is now so extensively used all over the civilised world.

Thea Bohea, or *nigra* and *viridis*, are said to be the principal species from which tea is obtained. The leaves of *Camellia sasanqua*, and other species of that genus, are also frequently used. These, however, must probably be looked upon as adulterations. The tea districts in China extend from the twenty-seventh to the thirty-first degree of north latitude, and in Japan they reach the forty-fifth degree. Some attempts have been made to rear the tea plant in Europe, but they have not been attended with any degree of success. It thrives well at Rio Janeiro, where it has been lately cultivated.

The tea plants are raised from seeds, and suceeded best in sandy or stony soil on the sides of mountains. The leaves are first gathered when the planes are three years old. After six or ten years, the plants are either removed or cut down, so as to throw out new shoots and leaves. The leaves are usually plucked at two seasons of the year, spring and September, the finest and most esteemed being those which are gathered first. They are picked one by one, and after being carefully selected, are exposed to the steam of boiling water, and then heated to a considerable degree on iron pans placed over furnaces, so as to be dried, and deprived of any acrid juice which they may contain. They are then transferred, while warm, to large tables covered with mats, where they are cooled by means of large pans, and at the same time rolled up with the hand. This process is repeated several times, a smaller degree of heat being applied each time, until all the moisture is completely expelled. They are afterwards mixed with some aromatic herbs, such as the leaves of the *Camellia sasanqua*, and the flowers and buds of the *Olea fragrans*, and are then put into boxes fit for exportation. In the finest sorts of tea, each of the leaves is rolled up separately.

It has not been fully ascertained whether the black and green teas are furnished by separate species, or whether the difference between them is merely to be ascribed to the age of the leaf and the mode of its preparation. It has been ascertained that they are cultivated in distinct districts, but many authors consider them as mere varieties. The green tea is said to be prepared from the leaf in an immature state, when it contains much of a narcotic juice, and to be dried by exposure to the open air in the shade.

Various varieties of tea are known in commerce which are designated by particular names. There are five or six different kinds of black teas, of which the chief are, bohea, congo or cong-foo, saotchong or souchong, and pekoa. Of the green teas the principal are, hay-suen or hyson, and tchu-tcha or gunpowder tea, which is rolled up in a round form. The green teas are chiefly prepared for exportation, as the Chinese only use the black.

All the teas ought to be carefully excluded from the air and light, in order to retain their flavour. They should be kept in wooden or leaden boxes, which are never left open.

Tea was first imported into Europe by the Dutch East India Company early in the seventeenth century. Some imported by them in the year 1666 was sold for sixty shillings a-pound. It was first used in Britain during the Commonwealth, and since that time its consumption has increased with amazing rapidity. In 1789, the tea retained in Britain for home consumption was 14,534,601 pounds, yielding a net revenue of custom and excise of 562,038*l.* 14*s.* 5*d.*; while in 1828, the quantity retained amounted to 26,790,481 pounds, and the revenue derived from it was 3,177,179*l.* 8*s.* More tea is consumed in Britain than in all the rest of Europe.

According to analysis, tea yields, by distillation, an astringent matter, and a bitter styptic extract composed of gallic acid and tannin. Tea is often adulterated with the leaves of other plants, more especially those of the *Camellia Japonica* and *oleifera*. The blossoms and buds of *Camellia sasanqua* are said to furnish a very strong and excellent tea. A kind of moss, found on the Chinese mountains, has been employed as a substitute for tea. In New Holland the leaves of the *Corrœa alba* are employed instead of tea, and in other countries we find those of the *Pedicularis lanata*, *Ceanothus Americanus*, *Ilex Paraguensis*, and *Symplocos Alstonia*, &c., put to a similar use. It was formerly stated, that the colour of green tea was owing to its being dried on plates of copper, but this is found to be an erroneous supposition.

Tea has now become a necessary article of food in Europe. This beverage, when prepared from the fresh leaves of the plant, is said to be narcotic, and hence the leaves are kept for twelve months by the Chinese before being used.

Good tea, taken in moderation, and prepared with cream and sugar, is highly refreshing and invigorating, and even produces a degree of exhilaration. The traveller, when exhausted by fatigue, and worn out by incessant toil, finds his strength renovated, and his spirits revived, by the timely use of this excellent beverage. It generally produces some degree o perspiration, owing probably to the quantity of hot water with which it is prepared. Tea sharpens the intellectual powers, favours digestion, and gives a new tone and vigour to the system. If tea, more especially green tea, is taken in large quantities, it is apt to produce nervous agitation, and to prevent sleep. In hysterical and hypochondriacal cases it may be productive of prejudicial effects. The infusion of tea is prescribed medicinally to promote the action of the stomach, to increase the flow of urine, and to cause gentle diaphoresis. Some authors have said that the habitual use of it prevents the formation of calculi, and favours the evacuation of gravel.

Camellia oleifera, oil-bearing camellia, a tree six or eight feet high, with white blossoms; is cultivated chiefly on account of its seeds, which furnish a limpid yellowish oil, used in China for domestic purposes. In order to obtain the oil, the seeds are reduced to a coarse powder, stewed and boiled in bags, and then subjected to pressure. The seeds of *Camellia sasanqua* also yield an oil which is used as an article of food in Japan.

Camellia Japonica, Japan rose; is a lofty tree found in the groves and gardens of Japan, and extensively cultivated in the greenhouses and conservatories of this country on account of its fine form, its rich green foliage, and its elegant red and white flowers. There are upwards of fifty garden varieties known in Britain. Of these the double red, double white, variegated waratah, double striped, peony-flowered, and fringed-white, are the chief favourites. The single red *Camellia Japonica* is propagated by cuttings, layers, and seeds, and is used as a stock on which the other sorts are reared. The camellias are the glory and pride of gardeners. They are best cultivated in houses expressly devoted to them. Some of them endure the winter well, when trained on a wall, and covered with mats. In order to make them flower freely, artificial heat and some degree of care is necessary. Their flowers, though remarkable for their beauty, are not at all fragrant.

CAMELOPARD. See GIRAFFE.

CAMERARIA (Linnæus), is the bastard manchineel; a genus of arborescent plants, natives of both Indies. Linnæan class and order *Pentandria Monogynia;* natural order *Apocyneæ.* Generic character: calyx of five teeth; corolla funnel-shaped, and hypocrateriform, gashes of the limb oblique; stamens inserted into the tube of the corolla; anthers acuminate, connivent, having their apices drawn out into threads; style scarcely any; stigma inconspicuous; seeds membranous, and peculiarly inserted. This genus is allied to the oleander of our greenhouses, and the periwinkles of our shrubberies. The flowers are beautiful, and fine ornaments of the stove, where the plants grow healthily in loam and moor earth. It is propagated readily by cuttings in sand, under a glass, in a little heat.

CAMMARUM is the title of a tribe belonging to the genus *Aconitum,* specifically distinguished by the sepals being deciduous; helmet conical, compressed; ovaries three or five; flowers blue, white or variegated, rarely flesh-coloured; root tuberous; lobes of leaves trapeziform, pinnate.

CAMPANULA (Linnæus). This is the bell-flower of our fields and gardens, a numerous family of herbaceous perennial plants, chiefly natives of Europe. Linnæan class and order *Pentandria Monogynia;* natural order *Campanulaceæ.* Generic character: calyx five-cleft; corolla bell-shaped or subrotund, limb in five divisions; filaments dilated at the base; stigma, in from three to five divisions; capsule three or five-celled, having lateral pores or bursting valves at the top. The campanulas are chiefly hardy, and grow in any common soil, in flower borders or on rock-work; and are easily propagated by parting the roots of the perennial species, and sowing the seeds of those which are annuals or biennials. The rampion, *C. rapunculus,* is cultivated for its roots, which are used as a culinary vegetable.

CAMPANULACEÆ. The bell-flower family. A natural order of dicotyledonous plants, containing twelve or thirteen genera, and about three hundred species. It is closely allied to the *Lobeliaceæ, Goodenoviæ,* and *Stylideæ,* from which it is, however, at once distinguished by its regular corolla. It approaches in habit, and in many of its characters, to the *Compositæ,* but differs from this order in its fruit and mode of inflorescence.

The essential botanical characters of the order are: tube of the calyx adnate with the ovary, usually five-cleft, equal and persistent; corolla monopetalous, deciduous or marcescent, regular, and generally five-cleft; stamens inserted into the calyx alternately with the lobes of the corolla, to which they are equal in number; anthers two-celled; pollen round; ovary two or many celled, many seeded; style simple, covered with collecting hairs; stigma naked; capsule inferior, opening by lateral irregular apertures or by valves at the apex; seeds small, and numerous, with a fleshy albumen

The plants belonging to this order are shrubs or undershrubs, with alternate simple and deeply-divided leaves, and flowers in racemes, spikes, panicles, or heads. Nine-tenths of the campanulaceæ have flowers of a blue colour, the remainder being white, and rarely yellow. They generally yield a milky bitter juice, possessing more or less acrid properties. When young, they abound in mucilaginous matter, and are much less bitter and acrid than when fully grown. The roots of most of them may be used as articles of food when young and properly prepared.

The campanulaceæ are natives of temperate countries, and are found in Asia, Europe, and North America. Out of three hundred species, only nineteen grow in tropical regions. Some curious species are found in the Canaries, St. Helena, and Juan Fernandez. Numerous species exist on the Alps, the Caucasian, and Altaian range of mountains, and a considerable number are found at the Cape of Good Hope.

The plants of this order are chiefly valued on account of their beauty, They constitute very striking ornaments of the fields, meadows, and forests of the countries which they inhabit. The chief genera are, *Campanula, Phyteuma, Canarina, Prismatocarpus, Trachelium, Jasione, Michauxia, Lightfootia, Adenophora, Wahlenbergia,* and *Roella.*

Campanula is a showy genus, the species of which are interesting, and easily cultivated. The name is derived from the circumstance of the corolla being in the form of a bell. In *Campanula,* or *Prismatocarpus speculum,* the corolla is like a small round mirror, and hence the plant is called *Venus's Looking-glass.*

Campanula rapunculus is cultivated in France, Italy, and Britain, on account of its white biennial roots, which are eaten as a salad under the name of *Rampion.* They are often gathered in spring before the stem appears, and in gardens they are frequently blanched. *Campanula persicifolia, Rapunculoides,* and *Trachelium,* are used in a similar manner. The last-mentioned species has bristles on its leaves, which are as pungent as those of a nettle, though not venomous. A decoction of the plant, which is bitter and somewhat acrid, was formerly employed in medicine as a garlic. *Campanula pyramidalis* is a tall handsome plant, which is cultivated in Holland as an ornament for halls and staircases. It was formerly very fashionable in this country, and is still frequently reared in drawing-rooms. It continues in flower for two or three months when left in the shade. *Campanula latifolia* is also a species which, from the beauty of its flowers, finds a place in our gardens. The young shoots, deprived of their epidermis, are boiled and eaten as greens about Kendal. *Campanula glomerata* is a very beautiful rock plant, well deserving of cultivation. In *Campanula linifolia*, before the panicle is produced, the leaves come out in a kind of rose on the summit of the stem. This appearance vanishes as the panicle expands. The roots are eaten in China both raw and boiled. The root and young shoots of *Phyteuma spicata* are used in Switzerland as articles of food. The roots and young shoots of the *Canarina campanula* are also used as food by the inhabitants of the Canaries.

CAMPELIA (Richard). An herbaceous perennial, indigenous to the West Indies, separated from the old genus *Tradescantia*. Linnæan class and order *Hexandria Monogynia;* natural order *Cammeliaceæ*. It differs from *Tradescantia* in having a three-lobed stigma, and a berry-like capsule.

CAMPHOR TREE is the *Cinnamomum camphora* of R. Brown, and the *Laurus camphora* of Linnæus. This highly fragrant forest tree is a native of the south-eastern parts of China and the neighbouring islands. Extensive groves of it are met with on both sides of the Canton river. The aromatic drug, camphor, is extracted from this tree, and it prevails more or less in the bark or wood, or leaves of all its congeners, viz. the cinnamon, cassia, sassafras, and even down to the sweet-bay of our gardens. All the species are propagated by layers and cuttings.

CAMPHOROSMA (Linnæus). A genus so called, because of its scent being like that of camphor. It contains one under shrub, and two annuals, natives of the south of Europe. Linnæan class and order *Tetrandria Monogynia;* natural order *Chenopodeæ*. They are plants of no beauty.

CAMPILODON (*Notacanthus* of Bloch). A genus of fishes, of which the history is very imperfectly known. There is but one known species, which is an acanthopterygeous or spinous-finned fish, belonging to the *Scomberoidæ*, or mackerel family, and as such an inhabitant of the surfaee, and a ranging fish, instead of being confined to the banks, as is the case with most bottom fishes. It inhabits more northerly than any other known species of the family, being found only in the polar seas, and there very near the ice. It is a poor fish, with the body very long in proportion to the thickness, and much compressed, covered altogether with small scales of a soft texture. The snout is obtuse, and projects forward beyond the mouth. The teeth are very fine, and closely and evenly set; there are two detached prickles, or spines, on the back; the ventral fins are placed backwards; the anal fin extends as far as the point of the tail; and the caudal fin is very short. Nothing whatever is known of its habits, or of the time or place of its breeding.

CAMPION. A name adopted from Pliny for the *Cucubalus baccifer* of Linnæus, and belonging to the class and order *Decandria Trigynia*, and in the natural order *Caryophylleæ*. Generic character: calyx bellying, cut into five revolute teeth, persisting; corolla has bifid petals, claws slender; stamens inserted alternately with the base of the petals, and round the germen; style like threads, persisting; capsule a berry, one-celled, with many seeds; placenta central and free. This is a common British weed, in hedges and in fields or poor ground, and is not easily extirpated, by reason of its long and tough root.

CAMPYLANTHUS (Roth). A genus of plants containing a single species found in the island of Teneriffe. It is a pretty little diandrious plant, and belongs to the order *Primulaceæ*.

CAMPYLUS (Fischer; Exophthalmus Latreille). A genus of coleopterous insects belonging to the section *Pentamera*, and family of the *Elateridæ*, or skip-jack beetles; being at once distinguished from the remainder of this extensive family by the exposed base of the head; the large and globose eyes, the long antennæ inserted beneath the elevated lateral margins of the head and the linear body. The genus comprises only one British species, the *Elater linearis* of Linnæus; but which is so exceedingly variable in colour, although not in form, that it has been regarded by many entomologists, including Linnæus, as constituting several distinct species, the *Elater mesomelas*, Linnæus, being one of these varieties. Mr. Stephens has, however, obtained the most complete evidence of the specific identity of these varieties. This insect is about half an inch long, varying in colour and spots from pale buffish red to black. It is generally distributed throughout England and Wales, and is found in hedges.

CANADA RICE. Is the *Zizania aquatica* of Linnæus, belonging to *Monœcia Hexandria*, and to the natural order *Gramineæ*. It is a water plant resembling rice, but the seeds are smaller and inferior.

CANADIAN MUGWORT. Is the *Artemisia Canadensis* of Michaux; and only found in the botanical collections of this country.

CANARINA (Linnæus). A genus of two species of herbaceous perennials introduced from the Canary islands. They are allied to the campanulas; flowering in our stoves in autumn and winter when few other plants are in bloom. The roots rest during summer when they require but little water. At the commencement of their growth, the late Mr. Sweet advises, that the plants be moved into the stove, where they will flower much more strongly than if kept in the greenhouse. They are increased by dividing the roots; or by cuttings placed in a mixture of loam and moor-earth under a hand glass.

CANARY-BIRD. See Carduelis.

CANARY-GRASS. Is the *Phalaris Canariensis* of Linnæus. It is cultivated in England, and other places for the sake of its grain, chiefly for the purpose of feeding cage-birds and poultry.

CANCELLARIA (Lamarck). A genus of moluscs, blended with the genus *Voluta* by Linnæus. They are, however, very unlike the *Voluta*, properly so called, *Maitra marginella*, or any other of the newly-formed genera, now separated from the genus *Voluta*. Many of the cancellaria are sub-canaliculated at the base, which never takes place in any species of *Voluta*. The shell is oval, globose and rugose; the spire moderate, aperture oval, with a very short canal at the base, sometimes hardly visible; the interior of the opening grooved; the columella with a few, or numerous irregular plaits, the greater number transverse; the exterior striated, cancellated, and generally rough to the touch; it has a horny operculum, and all the species are marine.

De Blainville does not altogether agree with Lamarck's arrangement of the species, and has separated from them all such as have the aperture evidently canaliculated, as in the *C. lima*, which he considers to belong properly to the *Murices* and turriculated *Turbinellas*. Of twelve recent species, he says the habitat of such as are known is in the Indian seas and Senegal. De France enumerates twelve fossil species, but more have since been described. In De Blainville's system this genus is arranged with the family *Entomostomata* ; first order, *Siphonobranchiata;* second class, *Paracephalophora*.

CANCERIDÆ (Leach). A family of crustaceous animals belonging to the order *Brachyura*, and corresponding with the genus *Cancer* of Fabricius, or the *Crabes arqués* of Latreille (see BRACHYURA). In this family, of which the common edible crab is the type, the four posterior legs are terminated by a narrow pointed and simple claw or hook, which is not dilated into a plate for swimming, as in the *Portunidæ*, of which the small edible crab, sold in the streets of London, is an example. The shell or carapace is curved in front into an arc of a circle, and gradually narrowed behind, being squared off between the two hind legs. The claws of the fore legs do not differ in size in the different sexes. The abdomen in the males is five-jointed, the central one being the largest, and in fact composed of three joints soldered into one, that of the female being formed of seven distinct joints.

Mr. Milne Edwards unites this family and the *Portunidæ*, mentioned above, and which are certainly very nearly related (their chief difference consisting in the dilated claws at the extremity of the four pairs of hind legs in the latter, whence they are termed shuttle crabs) into one family, *Cyclometopes*. (See the article BRACHYURA.)

It is to be understood therefore, that the modern family *Canceridæ* does not, like the majority of the families of insects, correspond in its limits with the great Linnæan genus from which it takes its name, but comprises only a small portion of the genus *Cancer* of Linnæus, which has been raised to the rank of the order containing numerous families, sub-families, genera, sub-genera, and species.

This group of animals therefore, affords an opportunity of entering into a few observations upon the modern nomenclature of natural history, a subject respecting which we constantly hear great objections raised. Let us not be understood, however, to wish to give to the study of names more than its due weight. Natural history is not a science of names alone, we have living objects for the subjects of our contemplation; and blind indeed must he be to the beauties of the visible world, who could look at a plant or an insect with no other interest than that of ascertaining its scientific name. The astronomer would be worse than mad who would regard the great luminaries of the universe with no other feelings for the benefits which they bestow, than that of a desire to prove their place in the "heavens above." But whilst we thus uphold the superiority of the observations of the economy, and natural history in its legitimate sense, of the animated world ; let us not disregard one of its important, although subservient adjuncts—that of names. We apprehend, indeed, that no one will deny their utility, the supposed abuse, not the use of the system being objected to. Should, however, any one object to the latter, and affirm that nature may be studied in all its details without the technical machinery of names, we shall feel no disinclination even to agree with him in this latter observation, so far as his own experience is concerned, but how greatly is the case altered should he wish to impart his knowledge. We have, indeed, only to refer to the highly valued memoirs of Reaumur, for a confirmation of our observations upon the utility of names; since it has unfortunately happened that many of his most interesting histories, for want of a precise determination of the animals whose habits are thus recorded, have been lost to science.

Admitting then the necessity of names, we are now to show the necessity of that extended system of nomenclature which, from having been so much paraded, to the exclusion of natural history, has caused great clamour to be raised by those who were led to believe, first, that our science was but a science of names, and secondly, that the system of Linnæan nomenclature was amply sufficient for every purpose, hence that the great multiplication of the minor divisions of the Linnæan genera was but an unnecessary frittering of science, having not the least utility, and tending only to disgust the student. Let us, however, look more narrowly at the subject, and endeavour to ascertain what are the grounds for these opinions. It cannot be denied that the machinery of nomenclature, like that of every other apparatus, must have had both a commencement and a founder. Take, for instance, the machinery of a time-piece, which in the early stages of clock-making was most cumbrous, notwithstanding its simplicity. Still, to a certain extent, it fully answered the purposes of its construction, that of dividing the day into a certain number of portions. By degrees, as the additions of the minute hand, the striking apparatus, and that of the divisions of a minute, of the repeater and that of the chimes were made, the machinery became more complex; and instead of simply turning round once in a certain period, we find wheel revolving within wheel, to an extent which to a savage has the appearance even of life itself.

Such is precisely the case with the nomenclature of natural history. Linnæus, the great inventor of the system, was indeed so well acquainted with the general relations of the great divisions of nature, that, although it is certain that his botanical far surpassed his zoological knowledge, it is a tribute which is willingly bestowed upon him by all, that in the construction of his general groups the modern naturalist must be compelled to tread, for a great extent, in his steps. Look, however, at the progress of zoology since the days of this great master. Take a single genus of insects—for instance *Carabus*, of which he described fifty-three species, and we find not fewer than two thousand five hundred contained in the single collection of the Baron Dejean, whilst the more minute peculiarities of organisation, both internal and external, have been studied with the greatest zeal by numerous authors. The discoveries of later days have likewise presented numerous groups, equal with those of the genera of which he was ignorant. Now this torrent both of novelties and of science has rendered the old Linnæan genera of such amazing extent, and so unwieldy, that entomologists, in their own defence, have been compelled to institute subdivisions of various ranks; for instance, if a person wish to record some fact concerning one of the Linnæan *Carabi*, he is enabled, instead of wading through the descriptions of two thousand five hundred species, to reduce the objects of his inquiry to one of the great sub-families of the Linnæan genus, and thus by the assistance of three or four other still more inferior sections, to bring his inquiry into the lowest possible compass. In doing this, however, a sufficient regard has been paid to the authority of Linnæus, by converting his genera into families, terminating uniformly, according to the admirable plan of Mr. Kirby, in *idæ*. Sub-families have been introduced, as we have shown in the article BRACHELYTRA, which are again subdivided into genera and sub-genera, which present varieties in structure of their different organs, while they agree in possessing the characters of the great family to which they belong. Now the advantages of this plan of names are evidently these:—1st, The peculiar construction of an animal is instantly called to mind by the naming of its modern generic or sub-generic names, whereas if the old Linnæan (but now family) title were employed, a very indefinite idea would alone be obtained: for instance, if we were merely told that a friend had observed the habits of one of the two thousand five hundred *Carabidæ*, we should be almost as completely in the dark as to its precise structure, as though we had been told that it was a beetle. 2nd, The beautiful perplexity arising from the employment of stars, and daggers, and asterisks, for sections of the Linnæan genera, is entirely removed. Those who, for instance, have studied as we have done, the invaluable *Monographia Apum Angliæ* of Mr. Kirby, will readily agree with us, that the benefit arising from the use of names, which in general carry some structural idea with them, is alone sufficient to overbalance the difficulty of bearing in mind either the sectional marks of distinction noticed above, or the names employed in their stead: and 3rdly, The immense saving of time gained by the student in investigating the species of his collection; since, if two thousand five hundred species of *Carabi* composed but one genus, as they do according to Linnæus, what person can be found with either time or inclination to identify the species of even a local collection. For general purposes, indeed, the employment of the old Linnæan names would, in many cases, be sufficient but for the ends of science, not only the modern generic but also sub-generic names must be employed; and a plan has been suggested by Mr. Robert Brown, which has the advantage not only of not materially disturbing the names already existing, but also of insuring the co-operation of two classes of naturalists at present opposed to each other, namely, by introducing the modern sub-generic name in brackets between the old generic and specific name, thus we should call the devil's coach horse, figured as *Staphylinus* (*Goerius*) *olens*. "This," as Mr. Brown observes, in the appendix to the narrative of travels and discoveries in northern and central Africa, "is analogous to the method followed by the Romans in the construction of the names of persons, by which not only the original family, but the particular branch of that family to which the individual belonged, was expressed. Thus the generic name corresponds with the *nomen* (Cornelius), the name of the section with the *cognomen* (Scipio), and that of the species with the *prænomen* (Publius)."

Naturalists have agreed in retaining for the old generic name those species which were more striking instances of the Linnæan groups. Thus, returning to the animals which have led us into this long, but we trust not useless digression, we find the large edible crab of the European coasts (*Cancer pagurus*, Linn.), regarded as entitled to retain the old generic name of *Cancer* by most authors, although M. Milne Edwards has very injudiciously formed it into a distinct genus, named Platycarcinus. The other genera in this family are Carpilius, Zozymus, Lagostoma, *Xantho*, Chlorodius, Panopeus, Zius, Pseudocarcinus, Etisus, *Pilumnus*, Ruppellia, and *Perimela*. These genera are for the most part established by Leach and Edwards upon structural differences alone, scarcely any thing being known of their habits. Those printed in italics are natives of our coasts.

CANCRIDA (De Montfort). A genus of molluscs, united by other authors to the genus *Crepidulina*, of which it is manifestly a species.

CANCROMA (Boatbill). A genus of birds belonging to Cuvier's *Pressirostral*, or compressed-billed family of *Echassiers*, long-legged or stilt birds. There is only one known species, a native of the tropical parts of South America; but the manners, and especially the appearance of this species, are very peculiar. It does not appear that the name *Cancroma*, or "crab-eater," is very accurately applied to this bird, though it does live near the waters, and it is in all probability a feeder upon the crustacea which these afford, but it is an inland bird; and as we more exclusively apply the word crab to marine crustacea, it were desirable that another epithet should be given to this bird.

The boatbill bears a considerable resemblance to the heron family, more especially to the night heron. As is the case in those birds, its bill is of great power, and its neck capable of much and rapid motion, so that it can strike and seize with great force and much celerity. Its bill is, however, very different in shape from those of the heron, and the epithet *pressirostral* does not apply to it, as its bill is the very reverse of being compressed. This, by the way, shows how injudicious it is to name a family of birds from the form of any particular organ, and, indeed, the general incorrectness of a system which classes birds by the bills at all. The food of birds is so miscellaneous, and the parts of their feeding apparatus so few as compared with those of mammalia, that they do not form a sufficient number of distinctive characters. In the mammalia themselves it is not the form of the jaws from which we infer the feeding, and, consequently, the general characters of the animals; it is from the teeth. Birds have no teeth; and before we can come at any thing like a satisfactory conclusion as to that food on which they feed, we must take an average of three qualities—the form of the bill, the texture and substance of it, and the character of the tomia, or cutting edges of the mandibles.

Viewing the boatbill in this, the only rational way in which we can view it, it is more nearly allied to the herons than with any other birds; and, notwithstanding the dissimilarity in the shape of its bill, it might, without much impropriety, be included in the same family, if not in the same genus.

The bill of this bird has certainly a very singular appearance. It is very much extended laterally, and seems like two small boats, or rather perhaps two spoons applied with their concavities towards each other. These large mandibles are very strong, their cutting edges are exceedingly sharp; and though they are not serrated throughout the whole length, as is the case of those of the herons, yet there is a strong and sharp tooth on each side of the upper one, near the point. From this structure of the tomia, we may naturally conclude that the bird is not a fisher, at least so much as the herons are, and that it lives upon food which requires more powerful action in the bill to prepare it for the stomach. Hence it is probable that crustacea, and the smaller reptiles, with shelly or scaly coverings, which frequent the margins of the waters, constitute the food of this bird.

The other characters are, the nostrils near the base of the bill, but the nasal groves continued so near the point, the feet, which have the tarsi reticulated, have four very long toes, three in front and one behind, which are divided, and almost free of membrane to their bases; and the wings are loose and concave, and less adapted for long flight than for ascending and descending. The first quill is much shorter than the second, the third is a little longer, and the fourth and fifth are the longest in the wing, which gives it a rounder form when extended. The hinder toe is turned rather inwards, so that the whole foot presents a broad base to the soft surfaces on which the animal alights.

The boatbill inhabits those plains on the banks of the Orinoco, and other rivers in similar parts of South America which are subject to flooding in the rainy season; and when these are under water, it is usually found sitting on the stumps of decayed trees, on the margin, or in the middle of the deluge, from which it is ever and anon dashing into the water, and catching such swimming substances as serve it for food; but as its feet have no webs, it does not alight on the surface, neither does it plunge into the water like the darter, and other birds which fish on the wing. Its food is taken either in the shallows or on the surface, and it darts upon its prey with great rapidity, or dashes along the surface, scooping the water with its large bill, in order to drive at the smaller animals upon which it preys. When in a state of repose, it has the same gloomy air as the herons, but, like them, it has a very keen eye, and, when once excited, the motion of its head and bill are very rapid and very powerful. Its head, as in many of the herons, and partially in all of them, is furnished with a crest of long feathers, which are pendent when the bird is in a state of repose, but which it erects when excited. There is no doubt that these feathers assist in guiding the motion of the bill, as they are found more or less in all birds which obtain their food by striking out with that instrument in the water or on its surface.

When the plains are dry and burnt up, and for a considerable part of the year they are so much so that no bird can find food upon them, the boatbill resorts to the margins of the streams, where it sits watching upon the withered stumps, till something appears to tempt its eye, upon which it dashes down to the surface, glides along a little way, scooping the water with its bill, and then returns to its perch. From this habit of dashing down on the water, it is probable that the bird catches fishes, or at least the small fry, but its habits have not been very minutely observed, and it is a bird of the wilds, rather than in the neighbourhood of inhabited places. It does not nestle in trees like the heron, but in the tangled bushes on the banks of the rivers. Its nest is carefully made, consisting first of a considerable number of small twigs, then of leaves and vegetable fibres, and lastly with an internal lining of down and feathers. The eggs are of a greenish-grey colour, and do not exceed two, or at most three in one hatch. The time of breeding, and the moults and other changes of plumage, are but imperfectly known.

There is but one species, *Cancroma cochlearia.* The upper parts are dull greyish; the forehead white; the top of the head black; and the nape furnished with a long flowing crest. The belly and flanks are rust-coloured; the breast white; the upper mandible blackish, the lower one whitish; and the feet greenish-yellow. The length is about one foot five; and the wings, though broad, are rather short in proportion to the size of the bird. These are the characters of the male. The female has the upper part more inclining to blue, with scapulars, and the crest black. The forehead and chin yellowish; the neck and breast white; the rest of the under part mottled with white and rust-colour; the bill reddish, and the feet brown. In the immature male the colours are considerably different. All the upper part is reddish ash; the forehead is pure white; the crown of the head black; and the crest, which is very long, is of the same colour. The lesser coverts of the wings are bluish; the cheeks greenish; the chin brown; all the under parts, including the under tail-covert, whitish; the flanks reddish, the feet

Cancroma cochlearia.

brown, and the bill blackish-brown. Some notion of the general form of the bird may be obtained from the above figure.

CANDLEBERRY MYRTLE. Is the *Myrica cerifera* of Linnæus. There are thirteen species of this amentaceous genus, inhabitants of different parts of the world. One is the sweet gale of Britain, and the wax-bearing one of North America is made a useful plant, by yielding an inflammable substance which serves for making candles. Hence the trivial name.

CANDOLLEA (Labillardiere). Is the name plant of the celebrated Professor De Candolle of Geneva. It belongs to the Linnæan class and order *Polyadelphia Polyandria,* and natural order *Dilleniaceæ.* Generic charactei: calyx of five sepals which are unequally persisting; corolla of five petals, stamens in five brotherhoods; anthers linear oblong; styles five; capsules five, each having too seeds, bursting inwards; seeds membranous, and inversely egg-shaped. This is a New Holland genus, being discovered there by the French traveller Labillardiere.

It succeeds well in our green-houses, and is propagated by cuttings planted in sand under a glass, and assisted by a little hot-bed heat.

CANDY TUFT. Is the *Iberis semperflorens* of Linnæus. It is a genus consisting of above twenty species, some of them undershrubs and perennial; a few are biennial, and above a moiety of them are annuals. They are natives of the south of Europe, and have long been introduced into this country for ornamenting flower borders and green-houses. The shrubby sorts are readily propagated by cuttings, and the annual sorts only require sowing in the open ground about the end of March.

CANE-BRAKE. Is the *Arundinaria macrosperma* of Michaux. It is a large coarse growing kind of reed indigenous to North America, and is ranked in the third class and third order of the sexual system, and in the natural order *Gramineæ*.

CANELLA (P. Brown). A genus of two species of lofty growing tropical trees. Linnæan class and order *Dodecandria Monogynia;* and natural order *Guttiferæ*. Generic character: calyx three-lobed; corolla, petals five, roundish, somewhat leathery; tube shorter than the stamens, and truncated; stigma in two or three divisions; berry two or three celled; seeds in pairs, and heart shaped. These trees are highly ornamental; both foliage and flowers being ample and showy.

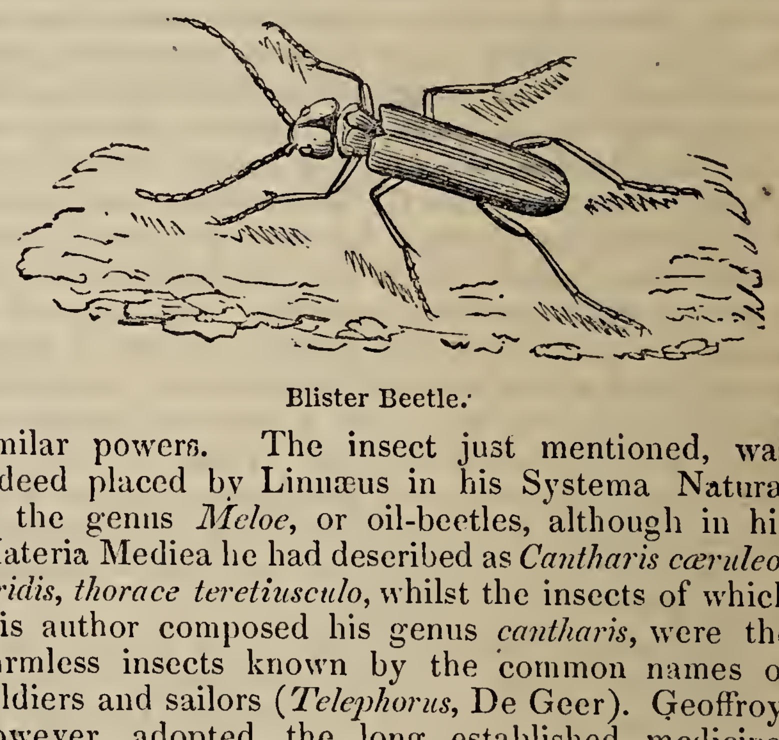
CANIS (the dog). A well known and exceedingly interesting genus, or, more strictly speaking, group of digitigrade mammalia, belonging to the carnivora, or flesh-eating division properly so called, of Cuvier's order *carnassiers*. The characters of this genus are: six incisive teeth and two canines in each jaw, six cheek teeth in each side of the upper jaw, and seven in the under, making in all forty-two teeth, of which there are twenty in the upper jaw, and twenty-two in the lower. The first three cheek teeth in the upper jaw and the first four in the lower are trenchant or tearing teeth. That immediately behind the canine in the upper jaw is very large, with two sharp trenchant points toward the outward edge, and a small tubercle on the inner side; the others are smaller, but they are all furnished with trenchant tubercles. The muzzle in all the wild varieties is elongated, the tongue is soft, the ears erect; the forefeet with five toes, the hind one with four only. Of the domesticated species the varieties are exceedingly numerous; and it is altogether impossible to refer them to any species at present known in the wild state. Particular accounts of them will be given in the articles Dog, Wolf, Fox, Jackall, and some of the allied genera; while their relative position in the system will be pointed out in the article Mammalia.

CANNA (Linnæus), commonly called Indian shot, perhaps from the roundness and hardness of the seeds. Linnæan class and order *Monandria Monogynia*, being the first genus of the sexual system, and gives a title to an order in the natural system namely *Canneæ*. Generic characters: calyx double, each three-parted, somewhat coloured, superior; corolla of one petal, three-cleft, irregular, rather gaping; stamens, filaments like petals, having an anther attached to the margin; pistillum also like a petal, with a linear stigma fixed on the edge; capsule inferior, membranaceous, roughly muricated, of three cells, and three valves; seeds many, globular; albumen hard. One species of this genus has been known in Europe ever since 1561; and many new ones have been introduced lately. The foliage of all of them is beautiful, and their high-coloured flowers are attractive. *C. patens*, and *C. speciosa* are hardy, but most of them, particularly the *C. Indica*, require a stove or warm green-house. All the species are increased by dividing the roots, or by seeds, which ripen well in this country.

CANNABIS (Linnæus). This is the plant which produces the hemp of commerce. Linnæan class and order *Monœcia Hexandria;* natural order *Urticeæ*. Generic character: male flowers in panicles, calyx of five sepals; corolla none; anthers four-furrowed, two-celled; female flowers aggregated, scales hollow, germen round; styles two, thick at the top, hairy; caryopsis or seed-vessel contains the seeds, which have the embryo inclosed between two thick cotyledons. Hemp has been long cultivated in the northern parts of Europe; its stem yielding the strongest filacious material of any known plant (except perhaps the *Phormium tenax*, or New Zealand hemp).

CANTERBURY BELLS. A large growing species of *Campanula*, common in gardens.

CANTHARIDÆ (Leach). A family of coleopterous insects belonging to the section *Heteromera*, and sub-section *Trachelides* of Latreille. The head is large and rounded posteriorly, the thorax is generally narrowed behind, and the claws of the feet are very deeply notched, appearing double; the wing covers are depressed at the sides. These insects counterfeit death when alarmed, and several of them emit from the joints a caustic fluid secreted by organs not yet observed by anatomists. The type of the family is the vesicatory cantharis or blister-fly of the shops. Many of the other species likewise possess



Blister Beetle.

similar powers. The insect just mentioned, was indeed placed by Linnæus in his Systema Naturæ in the genus *Meloe*, or oil-beetles, although in his Materia Medica he had described as *Cantharis cæruleo-viridis, thorace teretiusculo*, whilst the insects of which this author composed his genus *cantharis*, were the harmless insects known by the common names of soldiers and sailors (*Telephorus*, De Geer). Geoffroy, however, adopted the long established medicinal name of *cantharis* for the vesicatory beetles, but incorrectly called the *Telephori*, by the generic name of *Cicindela*. And in the former respect, the nomenclature has been retained by the French and English entomologists; but Fabricius having employed the name of *Cantharis* for the soldier beetles, and having given the name of *Lytta* to the vesicatory beetle, the Germans who have generally adopted his nomenclature, still employ the latter name.

The common blister-fly *Cantharis vesicatoria*, is generically distinguished by the possession of complete wings and wing covers, by having the joints of the tarsi entire and not bilobed, and the thorax nearly ovoid; the body is long and narrow, with the head rather larger than the thorax; the second joint of the antennæ is very small. This insect varies very much in its size, being sometimes not more than half an inch long, whilst others are twice that length. It is exceedingly rare in Britain, but has been occasionally taken near Cheltenham and elsewhere. Our figure is taken from a fine British specimen, purchased at the sale of Mr. Donovan's collection. It is of a golden or brassy green colour, very shining, and delicately punctured, with the antennæ (except the first joint) black. W. P. Audouin has published a valuable memoir upon this insect in the Annales des Sciences Naturelles, vol. ix., in which he has detailed in a very minute manner the external and internal anatomy, the sexual organisations &c. He states that the other species of this genus are numerous, being found in the south of Europe, Greece, China, India, and America, and very varied; but that since the time of Fabricius and Olivier, no one has undertaken their determination and description. The mandibles of the common species are strong, and terminated in a broad and oblique point, they are without teeth; but at the internal margin, below the middle, is to be observed a large notch filled with a yellowish membrane, which has escaped the notice of authors, but which is also found in various other heteromerous beetles. The legs also offer a curious peculiarity which do not appear to have been noticed before; in the female, the shanks (tibiæ) of all the legs, are terminated by two small moveable points or spurs, and the basal joint of the tarsi offers no material character; but in the males, although this character exists in the four hind legs, the two fore legs are terminated only by a large and strong spur, and the basal joint of the tarsi in this pair is strongly notched, so that the spur which is moveable, on being applied to the base of the tarsi exactly closes this notch, forming it into a sort of noose; this curious construction is employed by the males in coupling, to seize and retain hold of the antennæ of the females, a circumstance also noticed by Mr. Sowerby, to occur in *Meloe*.

But little is known of the early history of this insect. The female deposits her eggs separately, forming them into an agglutinated mass, they are buried under ground, and the larvæ there undergo their changes. It has been stated to feed upon the roots of vegetables, and to be soft and of a whitish colour, having six short legs. The descriptions given of the insect in this state are, however, very vague.

The perfect insect, although rare amongst us, must abound to a great extent in Spain and the south of France, where it appears about the summer solstice, being most abundant upon the ash and lilac, of which it devours the leaves, emitting a very penetrating odour somewhat resembling that of mice. This scent therefore leads to their discovery by the persons who collect them for medicinal purposes. When dead they are so light that fifty scarce weigh a drachm. It is necessary, however, to take various precautions in collecting them, since the odorous particles exhaled by them are very corrosive, that people have been violently affected whilst gathering them during the heat of the day with bare hands, or even when they have fallen asleep under trees, where swarms of them had settled. The ordinary mode of collecting these insects is to lay cloths under the trees where they abound, upon which they fall, upon the trees being violently shaken, they are killed by the vapour of vinegar, or they are collected in linen cloths previously steeped in vinegar. When dead they are carefully dried by exposure to the sun, or by lying in well ventilated apartments, being stirred about with short sticks or by the hand, covered however with gloves, since without this precaution the persons employed would be seriously affected by handling them. It is essential that they should receive a perfect degree of desiccation, otherwise they would contract a fetid odour, and be rendered unfit for medicinal purposes. They are preserved in close boxes or barrels, the insides of which are carefully covered with paper. It is not essential in this place to enter into a detailed notice of the well known medicinal properties of this insect, or the symptoms and mode of treatment when taken internally, or applied externally. It may be sufficient to state, that in the former case its powers are highly stimulating and dangerous, and that in the latter they first inflame, and afterwards excoriate the skin, raising a more perfect blister than any of the vegetable acids, and occasioning a more plentiful discharge of serum.

The Chinese employ another insect of this family *Mylabris pustulata*, for purposes similar to those of the *Cantharis vesicatoria*, whilst in North America the *Lytta vittata*, or potato-fly, and some other species appear to possess properties analogous to cantharides. For further details we must, however, refer our readers to the papers of Drs. Chapman and Woodhouse in the New York Medical Repository, vols. ii. and iii., and those of Drs. Schott and Dana in the Eclectic Repertory, vol. ii. The latter contains an analysis of the potato-fly, showing that cantharidam exists in it.

The other genera introduced into this family by Latreille are *Cerocoma*, *Hyclæus*, *Mylabris*, *Ænas*, *Meloe*, *Tetraonyx*, *Zonitis*, *Nemognatha*, *Gnathium* and *Sitaris*. Mr. Stephens has added another British genus named *Sybaris*.

The anatomical observations of M. Dufour, and the interesting researches of M. Bretonneau of Tours upon the properties of these tribes, allow us to dispose of these groups in a natural order, nearly agreeing with that stated above. The latter author having found that Sitaris is not vesicant, and the former, that it only possesses four instead of six biliary vessels, instead of six as in the rest of the family. They, however, in other respects, are nearly allied to zonitis, which are close to cantharis, so that by terminating the series with sitaris, it is easy by a comparison of other characters to ascend the series until we arrive at the other extremity, this progression moreover according with the progressive changes in the form of the antennæ. We shall notice the more remarkable of the above-mentioned genera in their alphabetical places.

CANTHARUS. A genus of spinous-finned fishes belonging to the *Sparoideæ*, or gilt-head family, but differing from the characteristic genera of the family in having teeth all round the jaws; those of the external row the largest, of a conical form, and more or less hooked. The body is elevated and thick; the jaws without any projectile motion; and the muscle short and rather blunt. There are two species, both in the Atlantic and the Mediterranean.

Cantharus Vulgaris (*Sparus Cantharus* of Linnæus). The general colour of this one is silver-grey, with longitudinal stripes of brown on the sides, and some small straight ones behind the bent ones.

Cantharus Brama (*Sparus Brama* of Linnæus). Nearly the same colour as the former but with all the teeth bent.

CANTHIUM (Lamarck). A single species of plants so called; said to be a Malabar shrub, belonging to *Pentandria Monogynia*, and to the natural order *Rubiaceæ*. Generic character: calyx of four or five sepals; corolla, tube short, limb in four or five divisions; stamens inserted in the throat of the corolla; stigma headed; berry dipyrena.

CAPE JASMINE. An English name given to the *Gardenia radicans*. It is one of the most fragrant of our green-house plants, and when healthy and in flower, one of the most beautiful.

CAPE PHILLYREA. Is the *Cassine Capensis* of Linnæus. It is an evergreen shrub with small roundish leaves, common in our green-house collections.

CAPER SPURGE. Is the *Euphorbia lathyris* of Linnæus, an herbaceous biennial indigenous to England. It receives its English name from the custom of using the seed-vessels as true capers, though much inferior in flavour.

CAPER TREE. Is the *Capparis spinosa*, or cultivated caper of Linnæus. There are nearly thirty species of this genus, mostly tropical plants, and some of them climbers. They belong to *Polyandria Monogynia*, and give a title to the natural order *Capparideæ*. Generic character: calyx in four divisions; petals four; stamens subperigynous, numerous or few; filaments like threads; anthers oblong and versatile; germen with a footstalk; style none; stigma obtuse and sitting; berry, barked, stipitate and many-seeded. The capers of commerce are imported from different ports of the Mediterranean and America; and in the south of Spain, France, and Italy, are extensively cultivated. See Capparideæ.

CAPPARIDEÆ (Caper Family). A natural order of dicotyledonous plants, containing seventeen known genera, and nearly two hundred species. It is closely allied to the *Cruciferæ*, from which it is distinguished by the stamens being scarcely ever, tetradynamous, and the seeds being kidney-shaped. De Candolle considers the order as intermediate between two sections of his arrangement, the *Thalamifloræ*, or *Calycifloræ*.

The essential botanical characters of the order are: sepals four; petals four, arranged in the form of a cross, and frequently provided with a distinct claw; stamens almost perigynous, definite or indefinite, and arranged in fours in several series; disk hemispherical, or elongated, and often bearing glands; ovary stalked; style wanting, or filiform; fruit, a single-celled, rarely single-seeded pod or berry; seeds generally uniform, without albumen; embryo incurved.

The plants belonging to this order are herbs, shrubs or trees, with alternate stalked leaves, which are either simple or palmate. They are chiefly met with in tropical countries, and abound in Africa. Some are found as far north as Canada. They are propagated by cuttings and seeds.

The *Capparideæ* resemble the *Cruciferæ* in their sensible qualities, being acrid, stimulant, and antiscorbutic.

The order has been divided by botanists into two sections; *Cleomeæ*, including the genera having capsular fruit and herbaceous stems; and *Cappareæ*, containing those with fleshy fruit and shrubby stems. The genera comprehended under the former are, *Cleome*, *Polanisia*, *Gynandropsis*, *Peritoma*, and *Cleomella*; while under the latter we have *Capparis*, *Cratæva*, *Niebuhria*, *Boscia*, *Stephania*, *Morisonia*, *Cadaba*, &c.

Capparis is the genus whence the name of the order is derived. *Capparis spinosa* is interesting on account of its furnishing the *capers* of commerce. It is an elegant, low shrub, having much of the habit of the bramble, and sending forth large white flowers with long purple stamens. It grows in the crevices of rocks, and on ruins, in the south of Europe. It is found adorning the walls of Rome and Florence, and is cultivated in the neighbourhood of Paris. In Britain it is generally reared as a stove-plant, and rarely succeeds in the open air. A plant, however, stood for nearly a century on a wall at Camden House, Kensington, and flowered pretty freely every year. Capers, so highly esteemed as a pickle, are the unopened flower-buds of the plant. During the proper season, they are picked in the morning before the petals expand, and are immediately put into vinegar and salt. The are afterwards carefully selected, and put into pure vinegar, and in this state are fit for exportation. The filings of copper are sometimes added, in order to give the pickle a fine colour. This addition, however, is highly dangerous, and ought never to be practised. The best capers are called *Nonpareilles*, the second-best *Capucines*. The chief supply of caper-buds is from the island of Sicily. The flower-buds of the *Caltha palustrus*, or common marsh-marigold, are sometimes used as a substitute for capers. In Italy, the unripe fruit is prepared like the buds. The root, got from the Levant by the Arabs, is used by them as a medicine, and as an external application to malignant ulcers. The bark of the root is said to be diuretic.

A species of *Capparis*, found near Carthagena, is said to yield poisonous fruit.

Capparis cynophallophora has large petals, and stamens upwards of four inches long.

Several species of *Cleome*, more particularly *Cleome rosea*, are very pretty and ornamental. Some of them have a very pungent taste. *Cleome icosandra*, or *Polanisia viscosa*, is used in some countries as a blister, or sinapism. The root of *Cleome*, or *Polanisia dodecandra*, is employed in the United States as a vermifuge, and its leaves are said to produce inflammation of the skin.

The bark of the root of *Cratæva Gynandra* produces blisters when applied to the skin. *Cratæva Tapia* yields a fruit of the size of an orange, having a garlic flavour, which it communicates to the animals that feed upon it.

CAPRARIA (Linnæus). A genus so called because goats are fond of the leaves. Linnæan class and order *Didynamia angiospermia*, and natural order *Scrophularinæ*. Of five species two are hot-house annuals, and three are under-shrubs. They are treated as stove plants; grow well in sandy loam, and are easily increased by cuttings planted in sand, and placed under a hand-glass in a warm temperature.

CAPRELLIDÆ. A remarkable family of crustaceous animals, belonging to the order *Læmodipoda*, and distinguished from the other family in this order which we have termed *Cyamidæ*, (and with which it was united by Dr. Leach, under the family name of *Caprellidæ*) by having the body of a very narrow and linear form, the composite eyes placed behind, the upper antennæ and ocelli wanting, and the legs long and slender, and variable in number, the end of the second pair being often toothed on its under side.

These curious insects are of comparatively small size, seldom exceeding an inch in length. They are generally found amongst marine plants, creeping along, according to Otho Fabricius, (*Fauna Grœnlandica,*) in manner similar to the looper caterpillars, throwing the head backwards in various directions, and vibrating their antennæ. When swimming they bend the extremity of the body. This family comprises three genera:—1st, *Leptomera* (Latreille), *Proto* (Leach), having the legs, fourteen in number, placed in a regular series. 2nd, *Naupredia,* having the legs, only ten in number, placed similarly, the second, third, and fourth pairs, being furnished with a basal vesicle. 3rd, *Caprella,* having ten legs, but placed at irregular distances, the second and third segments being destitute of legs. To the latter genus belongs the *Cancer phasma* of Montague, (*Cancer linearis,* Linnæus ?) described by Mr. Montague in the seventh volume of the Linnæan Transactions, by whom the following observations were made:—the

Caprella phasma.

female differs in possessing several plates or valves beneath the body, situated between the two pairs of fins, the use of which is to carry and protect its eggs or young, at which time they extend very considerably, and form a kind of pouch, distended with ova, fifteen or twenty of which are easily distinguished between the transparent plates. In this part a very strong pulsation is visible; whilst examining a female under a water microscope, this author was surprised to observe not less than ten young ones crawl from the abdominal pouch of the parent, all perfectly formed, and moving with considerable agility over the body of the mother, holding fast by their hind claws, and erecting their head and arms. On a fucus a vast number were collected of both sexes, and of all sizes, to three-fourths of an inch. When at rest they only held by their hind claws; in motion the arms were also used, and it also struck Mr. Montague that the progression was somewhat similar to that of the larvæ of the *Geometræ.* Some specimens are destitute of spurs on the body and arms, and differ somewhat in the formation of the latter, besides having that part extremely tomentose. These observations were made upon specimens taken on the coast of Devonshire. The writer of this article has received the same species from Weymouth, and Captain Ross has brought some very large individuals from his late North Polar expedition.

CAPRICORNES or LONGICORNES. One of the three great divisions into which the tetramerous beetles (or those having apparently only four joints in the tarsi) are divided, and corresponding in a great degree with the genera *Cerambyx, Necydalis,* and *Leptura* of Linnæus. These insects are generally of a large size, having the antennæ long, and generally exceeding the entire length of the body, filiform or setaceous, sometimes simple in both sexes, in others serrated or comb-shaped in the males. The eyes, in many of the species, are lunate, and enclose the base of the antennæ. The jaws are very robust, and the palpi short; the thorax is often spined at the sides. The three basal joints of the tarsi are dilated beneath, and cushioned on the under surface, the third* being deeply cleft at its extremity, receives a minute nodule or ball at the base of the slender and long terminal joint.

These insects are amongst the most active instruments in the economy of nature, in the warm climates of the globe, where, from their great size, they are of great service in checking the over-abundance of the vegetable world, the larvæ residing in the interior of trees or beneath the bark; in which state they appear under the form of a flattened white fleshy grub, broadest in front, with a scaly head armed with very powerful jaws, with which they bore their way through the hardest trees. From their habits in this state, it is evident that legs would be an incumbrance to them; they therefore are almost obsolete, and of a very minute size. The antennæ and the other parts of the mouth are likewise not exposed. Some species live upon the roots of plants.

This division comprises four great families, Prionidæ, Cerambycidæ, Lamiidæ, and Lepturidæ, which see.

CAPRIFOLIACEÆ (honeysuckle family). A natural order of dicotyledonous plants, containing twelve or thirteen genera, and upwards of one hundred and forty species. It is nearly allied to the *Rubiaceæ* and *Locanthaceæ.* From the former it differs chiefly in its irregular corolla, and the absence of stipules between the leaves; while it is distinguished from the latter by the stamens being alternate with the lobes of the corolla, and the corolla being usually monopetalous.

The essential characters of the order, as separated from all others are: calyx superior, limb five-lobed; corolla monopetalous, inserted on the calyx, sometimes irregular: stamens equal in number to the lobes of the corolla, and alternate with them, inserted on the calyx; filaments awl-shaped; anthers ovate, two-celled; ovary one to five-celled; one style and from one to three stigmas; fruit one or more celled, either dry, fleshy or succulent, crowned by the persistent lobes of the calyx; seeds generally solitary, pendulous; embryo straight; albumen fleshy; radicle superior.

The plants included in this order are shrubs, rarely trees, with opposite, simple or pinnated leaves, without stipules, and corymbose flowers, which are often sweet-scented. The colour of the flowers is white, scarlet or yellow.

The Caprifoliaceæ grow chiefly in the temperate regions of the northern hemisphere. They are found in shady cool places in Europe, Asia and America, and some are said to extend to the northern parts of Africa. They are propagated by cuttings, layers and seeds.

The plants of this tribe have often been celebrated for their beauty and fragrance, and on these accounts have secured a place in the garden of the amateur, as well as in the song of the poet. They possess acrid and astringent properties, and have often been applied to important uses.

* Latreille, in the second edition of the Régne Animal, has misstated the construction of the tarsi of this group, describing the second and third as being heart-shaped, and "le quatrième profondement bilobé."

The order has been subdivided into two sections: *Sambuceæ*, or the elder tribe, and *Loniceræ*, or the true honeysuckle tribe. In the former the corolla is rotate, the ovary three or four-celled, styles three or four, and flowers in cymes; it includes the genera *Sambucus* and *Viburnum*. In the latter the corolla is tubular, there is one style, and the berry is from two to four-celled, each cell containing one or many seeds. It comprehends the genera *Caprifolium, Lonicera, Triosteum, Diervilla, Abelia, Symphoricarpos, Linnæa*, &c.

The genera *Caprifolium* and *Lonicera* include many beautiful odoriferous flowering shrubs, which are highly prized in the garden or nursery. *Lonicera periclymenum*, or *Caprifolium Italicum*, the common honeysuckle or woodbine, has often been celebrated in poetry.

> "Watch upon a bank
> With ivy canopied, and interwove
> With flaunting honeysuckle."

It frequently supports itself by twining round other plants, and in doing so the stem invariably turns in one direction, from left to right;

> "So doth the woodbine, the sweet honeysuckle
> Gently entwine the maple."

Milton speaks of it under the name of the "twisted eglantine."—At other times it

> "loves to crawl,
> Up the low crag and ruined wall,"

and spreads over them an elegant and pleasing covering.

There are two other species of honeysuckle found native in Britain, the pale perfoliate honeysuckle, and the upright fly honeysuckle, but they are not so commonly met with as the species just mentioned. The bark of *Lonicera corymbosa* possesses astringent properties, and it is used in Chili to give a black colour to cloth.

Sambucus nigra, or common elder, is found abundantly in Britain. It blossoms in June, and ripens its berries in September. Sir James Smith says, that our uncertain summer is established by the time the elder is in full flower, and entirely gone when its berries are ripe. Its flowers are well known as a domestic medicine. They have an agreeable aromatic flavour, and possess laxative and sudorific qualities. They are chiefly, however, used in the form of ointment and fomentations. The smell from the plant is considered narcotic; it was formerly reckoned not safe to sleep under its shade. Cabbages, turnips, fruit-trees, or corn, whipped with the green leaves or branches of the elder are said not to be liable to the attacks of insects. The berries of the elder are poisonous to poultry, and the flowers to turkeys. The leaves, more especially the young leaf-buds, are nauseous, and act as violent purgatives. An infusion of the inner green bark in wine, and the expressed juice of the berries, act in a similar manner, although in a less marked degree. The berries contain malic acid, and have rather a pleasant taste. A wine is made from them, which is drunk warm with spices and sugar. They are used in the form of preserves, and are said sometimes to enter into the composition of adulterated port. The wood of the elder is hard and yellow, and is used by butchers, fishers, and turners. The pith, from its lightness, is used in a variety of electrical experiments. Sheep eat the plant, while horses, cows and goats, refuse it.

Sambucus ebulus, dwarf-elder or Dane-wort, another British species, possesses similar properties with the common elder. It has a fœtid smell, and is strongly purgative. Cattle refuse to eat the plant, and its leaves are said to drive away mice from granaries. The berries yield a violet colour.

The various species of *Viburnum*, two of which are natives of Britain, yield astringent fruit, which, after fermentation, is in some counties made into a sort of cake. The berries of the *Viburnum edule* or *oxycoccos*, are gratefully acid, and are used as food. The young shoots of *Viburnum lanata*, mealy guelder rose or wayfaring tree, are used in the Crimea for the tubes of tobacco-pipes. The leaves turn of a dark red in autumn, and the bark serves to make birdlime.

Viburnum opulus, common guelder rose, or water-elder, is cultivated in gardens under the name of the snow-ball tree. Its leaves, which are bright green in summer, acquire in autumn a pink or crimson tint.

Viburnum tinus, or *Laurestine*, is one of the most ornamental evergreen shrubs. Its showy white flowers appear during winter.

The genus *Triosteum* is intermediate between the *Caprifoliaceæ* and *Rubiaceæ*. *Triosteum perfoliatum* is a gentle cathartic when given in small doses. In large doses it acts as an emetic. Its berries, when dried and roasted, are used as a substitute for coffee.

The young branches of the *Diervilla* are used in South America as a remedy in some urinary affections. The roots both of the *Triosteum* and *Diervilla* are employed in America instead of Ipecacuan.

To this order belongs the humble and delicate, but highly interesting genus *Linnæa*, which has received its name in honour of the immortal Linnæus, to whom natural history and botany in particular are so deeply indebted. There is only one species, *Linnæa borealis*. It is a very elegant unassuming plant, found in native fir woods and in mountainous situations, in several parts of Europe and America, and eagerly sought by botanists, both on account of its beauty and its rarity. In Scotland it is found in several places, particularly in the counties of Perth, Angus, Inverness, and Aberdeen, while there is only one station as yet known for it in England. The plant has a bitter and astringent taste. It is used in some countries as a fomentation in cases of rheumatism, and an infusion in milk is esteemed in Switzerland in sciatica. The flowers are rose-coloured, graceful, fragrant, and drooping. Such, says Sir James Smith, is the little northern plant, the long overlooked object, flowering early, which Linnæus selected to transmit his own name to posterity. Few could have been better chosen; and the progress of practical botany in Britain seems to be marked by the more frequent discovery of the two-flowered *Linnæa*.

CAPRIFOLIUM (Romer and Schultes). Is the honey-suckle or woodbine, a sweet and well known plant all over Europe. Linnæan class and order *Pentandria Monogynia;* natural order *Caprifoliaceæ*. Generic character: calyx of five teeth; corolla tubular; swollen at the base, limb irregularly divided, two lipped, one in two, the other in three divisions; stamens protruding; berry one or two celled, sometimes three-seeded. A hardy plant like this, which is at every body's door needs no further description; but as there are above thirty species in the two genera of *Caprifolium* and *Lonicera*, and several varieties of each, it should be known that they are not all hardy; some of both genera requiring the shelter of a green-house. The caprifoliums (climbing like a goat!) are climbers; the loniceras (called after A. Lonicer, a German botanist) are mostly shrubby. All are propagated by cuttings planted in a shady place, and in almost any kind of soil.

CAPROMYS. A genus of Rodentia or gnawing mammalia, belonging to the rat family, and consequently to that division of the order which are furnished with clavicles. These animals have been known, in the island of Cuba, of which island they are natives, for more than three hundred years; but, as is the case with most of the natural productions of those parts of America which were, or are, in the possession of the Spaniards, nothing was known respecting them till within these few years; and we owe the best account of them to the indefatigable Desmarest.

The external characters of this genus place it intermediate between the rats, properly so called, which have their feet and toes slender, and produced, and their tails round, conical and scaly, and the marmots, which have their extremities stout and short. They are climbing animals, and not burrowing ones, as is the case with most of the order; they are nocturnal; and it is understood that they are chiefly or exclusively feeders on vegetable matter; but this is inferred rather than ascertained, for the manners of the animals are exceedingly obscure. They are plentiful in the woods of Cuba; but as they keep themselves carefully concealed during the day, it is rare indeed to get a sight of them. There is only one known species.

Capromys Furnieri, called the *Utia* or *Hutia* by the inhabitants of Cuba; and probably synonymous with the racoon rat of Brown's History of Jamaica. The size is about the same as that of a middling rabbit, but the head is rather longer, conical and a little compressed laterally. The extremity of the snout is truncated, and presents a large muzzle covered with fine skin of a deep black colour, free from any mucous secretion, and thinly sprinkled with very fine hairs. The nostrils are wide, placed obliquely, and approach near to each other at their inferior extremities, and their terminations are marginated. The upper lip is marked by a suture or furrow, very distinct. The opening of the mouth is moderate, as are also the incisive teeth, the only ones that have been examined. The eyes are also of a moderate size, very prominent, with brown irides, and they are situated rather nearer the basis of the ears than the point of the muzzle. The pupil, as in the greater number of nocturnal mammalia, is oval during the day, and has its axis vertical, as in the cats, thus indicating a climbing animal, or an animal which ranges for its food, in the vertical plane, and not the horizontal one. In this respect the animal is quite the reverse of hares and rabbits, and other rodent animals which seek their food on the surface of the ground. It does not appear that the eyes of this animal are able to bear the light; for during the day the pupil is closed to a perfect line, though in the twilight it is round and expanded, the iris appearing to have great sensibilility.

Sensibility in this part of the organ appears to be the chief reason why nocturnal animals, in general, see so badly in a strong light. This is very conspicuous in cats, and more so in owls, the pupils of whose eyes are so completely shut in clear sunshine, that the animals are helpless, and run themselves against any obstacles which happen to be in their way. It is, indeed, exceedingly probable that the power of vision in eyes depends much more on the sensibility of the pupil, or rather of the iris, than of any other part; and all animals, birds especially, which can bear to turn the eyes to the sun with unclosed eyelids, do not gaze on that luminary, or see it at all, but have the pupil entirely closed by the stimulating action of the light.

The eyelids and eyelashes of these animals are very handsome, the latter being long and neatly arranged. Their ears are rather more than a third part of the length of the head, shaped very similarly to those of rats: quite naked, of a black colour, and with a slight notch in the posterior margin. Their mustachios or whiskers are very long and moveable, and no doubt, as is the case with many other night animals, assist them in feeling their way. Their neck is short, the body much larger and thicker in the under part than anteriorly; and the back from the shoulders is considerably arched. The tail, which is equal to about half the length of the head and body, is very strong and muscular, conical, and surrounded by one hundred and fifty scaly rims, between which there are a few straggling coarse hairs. The legs are very stout, firmer in proportion than those of the marmots, especially the hinder ones. The fore paw consists of four toes, freely separated from each other, and furnished with strong and crooked claws; and there is a rudimental thumb or fifth toe, furnished with a small blunt claw, as is the case in most of the Rodentia. The second toe is the longest, the third the next, then the first, and lastly the fourth, as in the human hand. The hind feet have five toes, formed in a similar manner to those of the fore feet, but they, and also the claws with which they are furnished, are longer and stronger. The soles of the feet are covered with naked skin of a black colour, which is grained all over, and formed into tubercles or pads in the following manner:—four tubercles at the bases of the toes, three under the metatarsal bones, two on the middle of the toes, and one on the heel. The mammæ of the female are four in number, two pectoral and two abdominal, but they are of small size.

The hair is in general rough, and that on the part behind the head is turned forward, and forms a sort of crest at the nape. That upon the back and sides is long, and of two qualities, a fine one nearest the skin of a grey colour, and a coarser kind generally brown, but with yellowish rings near the point, and having the very points black. This gives a beautiful mottled colour to the whole covering, not unlike that of the agouti. The hair on the rump is harder than that on the other parts, it lies flatter to the body, and is of a reddish-brown colour. The hair on the breast and belly, which is very fine, but not very abundant, is sand-colour, a little inclining to grey. The hinder part of the belly is quite naked. The hair which forms the mustachios springs from the extremity of the muzzle. The feet are black; the hairs on the basal part of the tail are red, those on the distal part brown.

The name *Capromys* signifies a "hog-rat," the former part of the name applying to the rough and bristly hair on the upper part, their mode of walking on the ground, and various other characters; while in the form of their teeth, so far as known, and in that of their tails, they bear some resemblance to the rats, properly so called.

When in a state of nature these animals inhabit the woods, and climb trees with great facility. In reaching the leaves of those short plants which they do not require to climb, they make use of their tails as a third foot, something in the same manner as the kangaroos. Their expression is intelligent, their sight good; but it is probable that their sense of hearing is not so acute as that of the rabbits. Their natural cry is a squeak, not unlike that of rabbits; but when they are pleased, they express their satisfaction by a low murmuring grunt.

They live upon vegetable matter only; and in a state of domestication (for they are not very difficult to tame) they eat succory, cabbage leaves, aromatic plants, grapes, apples, and almost any vegetable. They drink tea; and do not refuse a bit of bread although soaked in anise-seed water or cherry-brandy; they are however somewhat mischievous, on account of their gnawing propensities. When a number of them are together and alarmed by any means, they gallop off with the same pace as hogs, and small as they are, their feet make a considerable degree of clattering. In consequence of possessing clavicles, these animals have a motion in their fore legs across the axis of the body, as well as a progressive motion, and thus they are enabled, like squirrels, and almost all the Rodentia which have clavicles, to bring their fore feet to their mouth, to lift their food with them, and otherwise to use them partially as hands.

CAPROS. A genus of spinous-finned fishes, closely allied to the doree (*zeus*), from which they were first separated by Lacepede. The dorsal fin is notched or divided as in the dorees, and the mouth is still more protrusile, but they have not the long fibres on their dorsal and anal fins. Their whole bodies are covered with strong scales. There is only one known species, a native of the Mediterranean, of a yellow colour, small in size, and of little value. It is the *Zeus aper* of Linnæus.

CAPSA (Lamarck). A genus of molluscs, separated from the genus *Donax* in consequence of some slightly defined differences, not, however, sufficiently well grounded, in our opinion, to sanction its adoption, as they may, with equal truth, be considered allied to the genus *Tellinides*, although without lateral teeth, as also the genus *Psammobia*, and to certain *Tellens*, by the similarity of the cardinal teeth; but they have not the flexuous bend of the *Tellens*; and if the hinge is to be the only certain guide, there are not any two species of *Donax*, or of Lamarck's *Capsa*, as he defines it, sufficiently well characterised to afford a certain rule; we therefore consider this genus no other than a section of *Donax*.

CAPSELLA (Moench). A new name and genus, separated from the old and well known British weed, the *Thlaspi bursa pastoris*, or shepherd's purse of Linnæus. This weed is luckily an annual, which with its five varieties found in England, are all easily destroyed by the hoe.

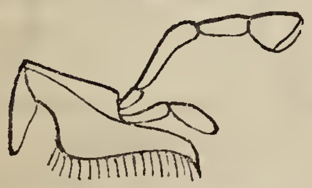
CAPSICUM (Linnæus). So called from its biting or pungent qualities. It is placed in the fifth class and first order of Linnæan botany, and in the important order *Solaneæ*, of the natural system. Generic character: calyx five-cleft; corolla rotate; limb plaited, in five divisions; stamens, filaments short; anthers conniving, bursting lengthways; berry assuming many shapes, two-celled, placenta fixed by the base, seeds adnate on the dissepiments. The fruit of the capsicum are universally used as a spice, as pickles, or as a preserve. In countries where it grows naturally, it is used by all ranks as a condiment to milder vegetables; and its action on the stomach is said to be necessarily stimulating, and sanatory in hot climates. In this country the capsicum was long cultivated as an ornament only; but is now become a material article of culture by the market gardener. Seeds are sowed in a hot-bed in March, and when advanced enough to handle, are pricked out into small pots of rich soil, and kept nursed in the hot-bed, and shifted as they grow into pots of larger size. In these they are suffered to produce their fruit in a green-house, or glazed frame; or about the beginning of June, the plants are turned out into a south border in the open ground, where they will flower and fruit abundantly. There are many varieties; some with very large, long, or heart-shaped fruit, others small and slender. The small fruited yellow sort, called in the West Indies hen-pepper, is by far the most pungent.

CAPSIDÆ. A family or rather sub-family of hemipterous insects, separated from the great Linnæan genus *Cimex*, and corresponding with the ninth family, *Astemmites*, described in M. Laporte's memoir upon this group of insects. We have, however, considered it more correct to employ the old Fabrician name for that of the family, and to adopt the ordinary uniform termination as proposed by Mr. Kirby. This group belongs to the section *Longilabres*, in which the rostrum or proboscis is four-jointed, with the upper lip long and acute, with transverse stripes. The joints of the rostrum are nearly of equal length, differing in this respect from the *Coreidæ*, the ocelli likewise are wanting, whilst the antennæ have the two last joints very slender and thread-like. These insects are very numerous, for the most part of small size, and of lively colours, amongst which yellow, red, black and green, are prominent. They are found upon trees and shrubs, the tender parts of which they suck: they are also said to suck the honey of flowers; they certainly are fond of some kinds of fruits, and it is not uncommon to recognise raspberries especially, which they have sucked, by the disagreeable taste which they impart to the fruit. Without being precisely social, it is common to meet with a considerable number upon the same plant. They walk and fly with much agility, escaping more quickly by the latter mode than the majority of the long-lipped *Cimicidæ*, or field bugs.

The family comprises the genera *Capsus*, *Heterotomus*, *Miris*, *Phytocoris*, *Orthonotus*, *Azinecera*, *Stenodema*, *Odontopus*. *Euryopthalmus*, and *Astemma*, the first six being British. The genus *Capsus* is distinguished readily by its oval form, lively colours, and antennæ having the second joint terminated by a club. The *Cimex ater* of Linnæus is the type; it is a very common British species, about one-third of an inch long, and entirely of a shining black colour. The genus *Azinecera*, of Stephen's catalogue (not yet described), is of a narrower form, with the antennæ of the males singularly curved and clubbed at the extremity of the second joint, whilst it is simple in the other sex. We have met with the type repeatedly at Coombe wood; it does not, however, appear to have been yet described.

CAPULUS. A genus of molluscs, of the family *Calyptracea*; the animal conical, but sometimes sub-spiral; the tentacula, foot, and branchia, as in the genus *Crepidula*, hereafter described. The shell is irregular and conical; the summit more or less inclined, and twisted backwards towards the posterior edge; the aperture is rounded, the margins irregular, the cavity deep, with a horse-shoe muscular impression open towards the front of the shell, and the termination of its ends rather unequal. Its trivial name is the foolscap limpet. The genus is divided into three species: those which have the summit slightly defined, and not inclined to one side, as in the *C. conicus;* those with the summit distinctly marked, and a little twisted, as in *C. ungaricus;* and those which are sub-spiral, as in the *C. intorta.* Four recent species are known, and six fossil. De Blainville does not admit of sufficient evidence to establish Lamarck's genus *Pileopsis* from the species of this family, and Sowerby considers the *Pileopsis ungarica*, commonly called the foolscap limpet, and its congeners, to belong more properly to the genus *Hipponix* of De France. They are found in all the seas of warm climates.

CARABIDÆ (Leach). A family of coleopterous insects belonging to the section *Pentamera*, and forming with the family *Cicindelidæ*, a sub-section named by the French authors, *Carnassiers terrestres* (*Adephaga geodephaga*), or voracious ground beetles. This family comprises the genus *Carabus* of Linnæus, with a few of the *Cicindelæ*, but which, as we have already stated, in our observations upon the modern system of nomenclature, under the article *Canceridæ*, has now become so extensive, that not fewer than two thousand five hundred species are possessed by the Baron Dejean alone; it has therefore become necessary to distribute this immense number of species into various minor groups, and accordingly Mr. Mc Leay, adopting the divisions, but not the names of Latreille, has divided them into four groups, which he terms families, named *Brachinidæ*, *Scaritidæ*, *Harpalidæ*, and *Carabidæ*, to which Mr. Stephens has added two others, *Elaphridæ* and *Bembidiidæ*. It appears to us, however, to be much more convenient to retain the family name in its original extent, and consequently to consider all these groups as subfamilies, to which the family name of *Carabidæ* may be jointly applied. We have, however, followed in the usual train, and have already given the BRACHINIDÆ (which see) as a family. In this article, therefore, we shall give a short sketch of the higher groups, *Adephaga* and *Geodephaga* (the family CICINDELIDÆ being so near at hand); we shall then characterise the *Carabidæ* in its Linnæan extent, and complete the article by a notice of the sub-family, as we propose to consider it of the *Carabides*, and its genera. In examining the organs of the mouth of the coleopterous insects, the greatest variety will be



Under jaw of Carabus.

found to exist in their construction. In none of the parts, however, is this so observable as in the lower jaw and its appendages. Theoretically speaking, this organ consists of a transverse base by which it is attached to the head, an upright stem supporting externally an articulated limb or the maxillary palpus, next an elongated lobe, and internally a second lobe. In many instances these two lobes are either quite soldered together, or one of them becomes obsolete; but amongst the predacious beetles, including the four Linnæan genera, *Cicindela, Carabus, Dytiscus,* and *Gyrinus*, we find the lobes not only perfectly distinct, but also the outer one transformed into an articulated feeler; hence these insects have been ordinarily described as possessing six palpi, in addition to which the internal lobe of the lower jaw is scaly, and terminated by an acute point or by a moveable claw, beneath which the same organ is ciliated with strong bristles. Now these characters clearly indicate a very increased power possessed by the parts of the mouth, the upper jaws being also horny, and very strong and toothed; and we accordingly find that these insects are amongst the most ravenous of beetles, preying for the most part upon living insects, being in fact the tigers and sharks of the beetle tribes; hence their names of *Carnassiers* or *Adephaga*: but another peculiarity amongst carnivorous animals is found in their increased powers of motion; and we accordingly find this character also strongly impressed upon these insects. The legs are generally long and slender, and well formed for activity; the anterior pair are inserted at the sides of the compressed prosternum, and implanted by means of a circular ball or rotule, which gives them great powers of motion; but here we find that although the organisation of the mouth indicated identity of predacious habits, the organisation of the legs as clearly evinces the nature of the element in which the different groups reside. The terrestrial species (*Cicindela* and *Carabus*) having the legs formed for running, are accordingly termed *Geodephaga*, whilst the aquatic species (*Dytiscus* and *Gyrinus*) having the legs formed for swimming, are termed *Hydradephaga.* In the former the legs are placed at nearly equal distances, the posterior coxæ being much smaller than in the aquatic species, and not soldered as in them, to the poststernum. The body is likewise generally oblong, with the eyes large and prominent, the jaws are likewise not concealed by the upper lip, whilst the breadth of the thorax never surpasses its length.

It would be a curious inquiry to trace out through nature the parallel analogies which these two groups of insects exhibit in their terrestrial and aquatic predaceous habits, but it is one which we have neither time nor space to enter upon at the present.

The predacious land beetles form two families corresponding with the Linnæan genera *Cicindela* and *Carabus.* The latter, to which we must now restrict our observations, is distinguished from the former by having the under jaws terminated in an acute but not articulated point. The lower lip is exposed with the labial palpi three-jointed only, the first joint being soldered to the lip and immoveable, and serving as a support to the long second joint. The character adopted from the toothed upper jaws, which has been employed to separate the two groups, admits of some exceptions, as in *Scarites, Pamborus,* &c., although generally speaking the mandibles of the Linnæan *Carabi* are but slightly toothed. The head is likewise in general narrower than the thorax. These insects are preeminently runners, whilst the *Cicindelidæ* are fliers; indeed in many instances the wings are entirely wanting in the former, the elytra being soldered together, but this character is by no means indicative of distinction of species, as has been asserted by various authors, since under peculiar circumstances, of the nature of which we are entirely ignorant, these wingless species, for some purpose or other, are found to possess wings fully developed. On this subject, respecting which our chief authors are at variance, Mr. Stephens justly observes :—" The most that can be alleged is, that certain species have a greater tendency to be apterous than others, and *vice versa*, e. g. *Omaseus nigrita* is generally winged, but I have several examples lately taken that are perfectly apterous. The same may be added of *Achenium depressum* (one of the *Staphylinidæ*), which is said to have mere rudiments of them, whereas the supposed males appear perfectly apterous, and among the females which I have examined are many with rudiments only, others with those appendages of greater bulk, and some with large and ample wings; these latter instances are evidently analogous to similar occurrences amongst the hemiptera, such as *Hydrometra, Stagnosum*, &c., which have also been found with ample ones."—Illust. Brit. Ent. Mand. i. p. 178. Our own observations upon Bolbocerus (which see) may also be referred to as affording a somewhat analogous instance of superiority of development in certain individuals of the same species.

The majority of the carabidæ emit a fetid odour, and discharge from the extremity of the body an acrid fluid, which, as already stated in Brachinidæ, is volatilised immediately on coming in contact with the air. By Geoffroy, as stated in our article Buprestidæ, these insects were regarded as the buprestes of the ancients, but which, from their stimulating powers, must rather have belonged to the family *Cantharidæ*.

These insects particularly inhabit the elevated regions of the northern parts of Europe, Asia, and America. Their chief metropolis appears to be in Europe, although in England we scarcely possess more than 400 species. Those of the restricted genus *Carabus* disappear as we approach the tropics whilst those of *Calosoma*, notwithstanding their evident affinity with the latter, reach even to the equator ; our observations upon this latter genus being thus amply confirmed. The species of another group nearly allied to the true carabi, *Procrustes*, appear to have established themselves in the countries washed by the Mediterranean, where likewise commences the region of the large brachini and scarites, which stretch to the equatorial countries, as well as certain species of *Graphipterus, Anthia*, &c., genera considered as more peculiar to Africa and the eastern parts of Asia.

These insects hide themselves beneath stones, the bark of trees, moss, &c.; other species frequent the margins of water or damp situations, whilst others, as some of the carabi, pterostichi, and helobiæ, frequent mountainous regions ; thus in the course of the last autumn we found numerous specimens of several of our rare British species within a few feet of the highest peak of Snowdon.

No group of insects has hitherto undergone so complete an investigation as the present. Paykull, Illiger, Weber, Clairville, Bonelli, Panzer, and Sturm, having devoted considerable attention to its elucidation, whilst more recently the descriptive work of Dejean, extending through six thick octavo volumes, will prove the assiduity of this author.

The following are the chief divisions, or as we would term them subfamilies, into which these insects are divisible—first, those with the anterior tibiæ notched.

1. *Brachinides*, having the elytra squared off at the extremity.
2. *Scaratides* having the elytra rounded behind and the abdomen pedunculated.
3. *Harpalides* having the elytra rounded, the abdomen not pedunculated, and the two last joints of the palpi equal.
4. *Bembidiides*, distinguished from the last by the minute conical terminal joint of the outer palpi.

Secondly, those with the anterior tibiæ not notched.

5. *Carabides*, having the antennæ long and slender.
6. *Elaphrides*, having the antennæ very short and stout.

Confining ourselves to the fifth of these groups, we find the carabides distinguished not only by the two characters above mentioned, but by the comparatively large size, brilliant metallic colouring, and extremely active and carnivorous habits of the species, as well as by the lower lip being small and conical, with lateral setæ or paraglossæ, the jaws very robust, and the large hatchet or spoon-shaped terminal joint of the external palpi, the eyes are prominent, and the abdomen in general large. Hence the terms abdominales and grandipalpi have been applied by Latreille to this section. The species are in general destitute of wings. The genera are Pamborus, *Cychrus*, Scaphinotus, Sphœroderus, Tefflus, Procerus, *Procrustes, Carabus, Calosoma, Nebria, Helobia, Alpæus, Leistus*, and Omophron. Those printed in italics are British genera.

The genus Carabus, notwithstanding the very restricted manner in which it is now regarded, is still a group of great extent, containing upwards of 160 species, of which nearly twenty are natives of our own country. They are generically distinguished by the dilated tarsi of the males, the bilobed upper lip, the absence of wings, the smooth jaws, and the entire tooth in the centre of the mental notch. The majority of the British species have the elytra soldered together, whilst *Carabus cancellatus* has them capable of motion, and is furnished with rudimental wings. Considerable confusion has arisen in the nomenclature of the British species.

C. clathratus.

Amongst the rarer indigenous species of this genus is the *C. clathratus* of Linnæus, a very handsome species, about an inch long, of a dark greenish brassy colour, with three elevated ridges upon each elytra, between each of which is a row of very deep golden excavations. It has been found in Norfolk and Scotland, but it occurs more plentifully in the neighbourhood of Dublin. Our specimens are from the neighbourhood of Belfast.

CARACALLA. Is the specific name of a sort of kidney-bean (*Phaseolus caracalla*) cultivated in India; it is also the title of a subtribe of that genus.

CARAGANA (Lamarck). A genus allied of plants to the *Robinia*, and so called from the aboriginal name given to the Siberian pear-tree. Linnæan class and order *Diadelphia Decandria*, and natural order *Leguminosæ*. Generic character: calyx, bell-shaped, five-toothed; keel obtusely erect, vexillum equal with the wings; style smooth; pod sitting, cylindrical, with a sharp point. This genus are mostly deciduous shrubs, with yellow flowers and fine foliage. They are rather difficult to propagate, and are most commonly worked on the *C. arborescens*, which is raised from seeds, and sometimes by layers.

CARALLIA (Roxburgh). An East Indian tree, so called by the natives of Hindoostan. Linnæan class and order *Dodecandria Monogynia*, and natural order *Rhizophoreæ*. Generic character: calyx globular at the base, limb six or seven-parted; petals six or seven, roundish; stamens inserted on the calyx; anthers erect; style simple; stigma three-lobed, berry, globular, one-seeded and crowned with the calyx.

CARALLUMA (R. Brown). A curious under shrub, so called in India, formerly supposed to be a *Stapelia*. Linnæan class and order *Pentandria Digynia* natural order *Asclepiadeæ*: calyx five-parted; corolla somewhat rotate, and in five divisions; corona round the seed-vessel consisting of ten leaflets; five of the folioles bear, and are opposite the anthers; gynostegium protruding. This ranks among our succulent plants, and thrives best in brick rubbish and loam. No water should be allowed to stagnate in the pot, very little of this being required, except at the time of flowering, when they want a good deal; but at this time they also require a high temperature. The plant may be increased by cuttings; but must be laid on a shelf to dry and get withered before they are put in dry soil. If potted as soon as cut off, the great discharge of sap from the wound instantly rots the cutting.

CARANX. A very numerous and widely distributed genus of spinous-finned fishes, belonging to the mackerel family, and so nearly resembling the true mackerel, at least in some of the species, as to be called by the popular name of *Bastard* Mackerel. They are very numerous, being found in all seas, and in all parts of the sea, or at least of those wide seas in which the true mackerel are found; but it does not appear that they collect in such numerous shoals on some parts of the coast as these fishes. As is the case with most of this very important family, they are wholesome and pleasant as food, but, as is the case with the others, they very speedily die when taken out of the water, and they as speedily become putrid. The large gill-openings, and remarkably free gills of these rapid-swimming surface fishes, are probably the chief cause of their speedy death when taken out of the water; and it is a very general law in the animal economy, that those animals in which the functions of life are most energetic, putrify the soonest after they are dead. We have a remarkable instance of this in trout and eels, the latter of which can be kept much longer wholesome without salt than the former; and we have a similar instance in mackerel and skate.

The general economy of the genus under consideration will be treated of in the article FISH and in the article SCOMBEROIDÆ, so that we shall here barely notice the generic characters.

The name *Caranx* means "keel" or "ridged," and this is very expressive of the principal distinction between these fishes and mackerel. Along the lateral line there is a series of scaly pieces or bands, with ridges or keels in the middle, and often with spines. These bands extend from the pectorals to the insertion of the tail; they sometimes consist of as many as a hundred separate pieces upon each line, and they are a very distinct and easily observed character. They have two distinct dorsal fins, with a detached spine bent downwards in advance of the first one. The last rays of the second dorsal are very slightly united, and sometimes entirely separated. There are also free or detached spines, forming a little fin behind the anal.

The seas of Europe contain many of these fishes, and indeed they range, with small difference in appearance, over the whole of the ocean. They are found in the Mediterranean as far to the south-east as Alexandria; they are to be met with on the shores of North America, on those of Brazil, at the Cape of Good Hope, in the seas of Australia, and indeed everywhere except in the extreme of the Polar seas. The earlier naturalists included them as a species of mackerel (*Scomber*); but they are not only different from all the species of that genus, but they differ so much from each other, as to require division into several species, if not sub-genera. The same species is, however, exactly the same in appearance in whichever part of the world it is met with. The chief difference is in the number of carinated plates on the lateral line, and in the flexure of that line itself. Some of them have those plates continued the whole way from the shoulder to the tail, while others have them on the posterior or straight part of the line only, while the anterior, or arched part, is covered over with small scales. They have all the spindle shape of the common mackerel, but they differ considerably in the number of what may be called the supplemental fins. Some have only one of these after the dorsal, and others have several, but the greater part have none; some have the body very much elevated, and the lateral line consequently very much curved, but even these have the forehead with a rapid descent. The species are so numerous, that a particular account of them would fill a volume; but we must barely notice two, one found chiefly in the western, and the other in the eastern seas, though both are met with in the same. These are called in the French West Indies the *Carangue* and the *Bastard Carangue;* and though the difference in appearance between them is not great, it is well worthy of attention, inasmuch as the true fish is always wholesome, and the bastard ones generally poisonous. The *carangue* is of a silvery colour, with the exception of a distinct black spot of a distinct gill; and the bastard is exactly similar in shape and in general colour, and hardly differs from the other in size, but it never has the least vestige of the black spot. In the warm seas the esculent fish is a very important one; it is caught readily and in great numbers, and often weighs from twenty to twenty-five pounds.

CARANXOMORES. One of the five subgenera into which the genus *Coryphæna* has been divided.

The only difference between them and the true *Corypheus* is, that they have their head oblong and a little elevated, and their eyes in a medium position, instead of having the head high and rounded, and the eyes much depressed. See CORYPHŒNA.

CARAPA (Aublet). A genus of tropical trees belonging to *Decandria Monogynia* of Linnæus, and to the natural order *Meliaceæ.* Generic character: calyx leathery, in four lobes; petals spreading, and somewhat leathery; urceolus bearing fleshy stamens, having eight teeth; filaments linear, emarginate; anthers oblong, attached to the interior side of the filaments; style thick and short; stigma broad, margin furrowed, disc perforated; drupe large, sapless, globular, four-valved; nut inclining to eight-sided, containing one seed. These trees grow strongly in our stoves; having large glossy foliage, for which they are chiefly admired. They are propagated by cuttings.

CARAPUS. A genus of malacopterygeous, or soft-finned fishes, without ventral fins. It is closely allied to the celebrated electric eel (*Gymnotus electricus*), but it is without the electrical quality, and also without the proper characteristic of the *Gymnoti,* as it has the body covered with scales, whereas the *Gymnoti,* of course, have none. Its tail is much pointed. It is found in the fresh-water rivers of North America, but it is a fish of small value or interest. It would seem that, as is the case with the common eel in England, there are two species of this fish—the one with the muzzle blunt, and the other with it pointed.

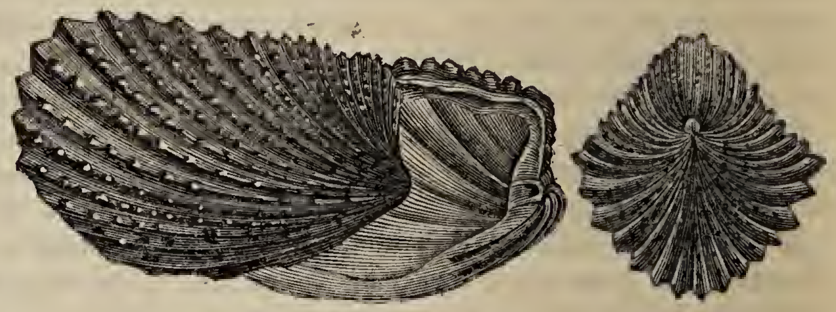
CARAWAY is the *Carum Carui* of Linnæus. It belongs to *Pentandria,* and to the natural order *Umbelliferæ.* It is an herbaceous biennial, and cultivated in England and other parts of Europe for its seeds, which are indispensable to the confectioner and druggist.

CARDAMINE (Linnæus). A genus of herbaceous annuals and perennials, growing in water or in moist ground. They belong to the *Tetradynamia* class of Linnæus, and to the natural order *Cruciferæ.* Generic character: calyx erect; pod linear; style very short, or none; valves plane, nerveless; seeds in one viscera. *C. pratensis* is the common cuckoo-flower, one of the earliest spring flowers frequent in damp meadows.

CARDAMOMUM is the *Alpinia Cardamomum* of Roxburgh. The seeds, produced by a perennial herb in India, are of a fine aromatic flavour, and much used as a spice in high cookery and confectionary, as well as in medicine.

CARDIOSPERMUM (Linnæus). A genus of ornamental climbing plants, chiefly natives of South America. Linnæan class and order, *Octandria Trigynia;* natural order, *Sapindaceæ.* Generic character: calyx funnel-shaped and four-lobed; petals four, inserted in the calyx; stamens inserted in a double order on the calyx, opposite the petals; anthers two-celled, bursting longitudinally; style acute; fruit nut-like, one-seeded; seed pendulous. Several of this genus are in our hothouses. They are grown on loam and moor-earth, and propagated by cuttings.

CARDITA (Lamarck), *Chama* (Linnæus). This genus of molluscs was included in the genus *Chama* by Linnæus, from which, however, it most essentially differs, the teeth being of another form; the valves are always equal, and the shell is never affixed by its lower valve to other bodies. The shell is equivalved, regular, and inequilateral, the greater number of species appearing longitudinal, from the great elongation of the anterior side. The hinge has two unequal teeth, one short, straight, and placed beneath the umbo, the other oblique, marginal, and prolonged, being inserted into a corresponding fossuli. The valves are more or less strongly ribbed, smooth, or imbricated; the internal margin crenated or plaited. De Blainville, in his System of Malacology, has arranged the species of *Cardita* in the following order: first, those that are elongated, slightly notched, or gaping at the inferior side of the ligaments, concealed as in the *C. crassicosta,* forming the group of *Mytilicardia;* secondly, the oval species, the inferior sides of which are nearly straight, or slightly arched, crenulated, and completely closed, forming the group *Cardiocardita,* as in the *Cardita Ajax;* thirdly, such as are nearly round, or suborbicular, the inferior side rounded, denticulated, still more equilateral, with the two teeth shorter and more oblique, constituting the genus *Venericardia* of Lamarck, of which the *V. imbricata* is an example; and lastly, the elongated species, very inequilateral, the summit turned forward, two short divergent cardinal teeth, besides the lamellar one; the ligament very long, slightly, or not at all salient; the abdominal impression sometimes a little placed backward, forming Lamarck's genus *Cypricardia,* an example of which is the *Cardita guinaic.*



C. caliculata.

Lamarck enumerated twenty-five species of *Carditæ,* of which one only is fossil; eleven *Venericadia,* all fossil, with the exception of one; and seven *Cypricardiæ,* four of which are recent, and inhabit the seas of warm countries.

Some of the species are presumed to spin a byssus, and it appears that they all of them live in situations only occasionally overflowed by the sea.

CARDIUM (Linnæus, Lamarck). From the constantly well-defined characters of this genus of molluscs, little or no change has taken place in the arrangement of modern naturalists and that of the great Linnæus. It is an interesting and elegant family of shells, whose symmetry of form is not surpassed by any other mollusc; they are variously sculptured, and the convexity of the valves, like the genus *Pecten,* is ornamented with numerous longitudinal ribs, more or less elevated, armed in many with spines; others are imbricated, or have hollow scales, and some merely marked with variously arranged striæ. The interior part is smooth, or only grooved at or near the margin, the valves are equivalve, subcordiform, apices protuberant, slightly curved forward; a complex hinge similarly formed of two cardinal teeth oblique and conical, and two other lateral teeth, inserted at a distance from each other, on each valve; the ligament is dorsal, very short, and the two muscular impressions on the valves generally but slightly marked; the increase of their growth is very distinctly visible, and each addition in some species overlaps the previous increase.

The animal is a *Tethys* of Linnæus, its body very convex, the mantle bordered with tentacular cirrhi round its inferior side, and more or less channelled on the outside, the tubes united, of a moderate size, and provided with cirrhi at their extremity. The foot very large, cylindrical, angular formed, and placed rather forward; branchia thick, rather small, particularly the external folds; the internal ones are united through their whole length.

This genus is arranged by De Blainville in the third class *Acephalophora*, third order *Lamellibranchiata*, seventh family *Conchacea*, and the species subdivided as follows: first, such species as gape more or less backwards, and the ribs as large as the grooves, of which the *C. exoticum* is an example; secondly, those with ribs similar to the first species, but the valves not gaping, as in *C. tuberculatum*; thirdly, the species not gaping, but whose ribs are greater than the channels, as in the *C. edule*, or common cockle; fourthly, the species smooth, or nearly so, as in *C. lævigatum;* and fifthly, such as have the anterior side very short and nearly flat, as in the *C. hemicardium*, forming Cuvier's genus *Hemicardium*.

Lamarck has made two divisions of this genus, distinguishing the first by having the anterior side as large or larger than the posterior, and without any very distinctly marked angle at the apices. The second, by the posterior side being often much larger than the anterior, and possessing carinated or angular umbones. In this division, as we have elsewhere observed, that elegant mollusc the *Cardium cardissa*, *Venus' heart*, as it is commonly called, has been placed with others of this genus, whose valves are angularly flattened, forming when closed a compressed heart-shaped shell, strikingly different to all other bivalves, in which the depression is in the opposite direction, where any exists. Though unacquainted with the anatomical structure of this mollusc, and not knowing any work in which it is described, we cannot but think that these species must be inhabited by an animal totally distinct from that which constructed the *Cardium costatum* and its congeners, and merits, from its strongly defined characters, the honour of a generic appellation; though modern malacologists do not appear to have made even a distinct division of them. There are several varieties of them, particularly those classed as *Cardium cardissa*, some very recently discovered; and it will be universally confessed that, amongst the many beautiful forms presented by other molluscs, not any is more truly pleasing and graceful, or altogether more wonderful in its structure.

The molluscs constituting the genus *Cardium*, with perhaps only one exception, inhabit the sea, where they exist, hidden at a small depth under the surface of the sandy beach, sometimes barely covered, the necessity of which appears obvious, from the shortness of the tube employed in drawing in and expelling the water. As a nutritious and agreeable food many are known, but the most common in this country is the *Cardium edule*, or common cockle. In the London markets it is not so often met with as in Scotland, where this mollusc is of a larger size, and far more generally an article of commerce.

The cardia inhabit the seas of all countries, and numerous fossil species indicate their having ever formed an important genus in natural history.

CARDOON is the *Cynara cardunculus* of Linnæus, a species of artichoke, the leaves of which are blanched, and used like celery. Like all the artichoke family, the cardoon contains a rank bitter principle, which is dissipated by blanching. The cultivation is simple. A piece of good rich light soil is prepared by digging, on which trenches are opened four feet apart, six inches deep and twelve wide. Along the middle of the trenches the gardener should drop patches of several seeds at eighteen inches apart.

When the seedlings appear, and have gained a little strength, they should all be removed with the exception of one from each patch. During summer, the growth of the plants is encouraged by keeping them free from weeds, and by occasional watering, if necessary. Towards the middle of October, the plants will be large enough, and ready for blanching. This is done on a dry day, by first gathering up all the leaves closely round the centre, and in that position binding them together with strands of mat or osier twigs. This done, each plant is earthed up in the manner of celery, so that the points of the highest leaves are only exposed at top. In two or three weeks the leaf-stalks will be sufficiently blanched and crisp, and then are fit for use, being digged up as wanted.

There are several varieties of the cardoon, namely, the Spanish, the common, the red, and the Tours. The first is esteemed the best both for size and delicacy of flavour. The cardoon is indispensable in French cookery, and is becoming much more generally used in England than formerly.

CARDUELIS (Auctorum). A genus of small conirostral birds, or rather perhaps a sub-generic division of the very extensive genus finch (*Fringilla*, Auctorum), and of which the common goldfinch and siskin of this country may be considered the standard. It contains several species, and the form, in one or other of them, appears to range pretty generally over the globe, although the distribution of each species separately is much more limited. They are about the most *typical* of all the finches, or, in other words, the various and peculiar characters which together constitute what we term a finch are more prominently observable in this particular division than in any other.

The bill is conical, longer than deep, compressed anteriorly, and drawn to a very fine point, the nostrils hidden by incumbent bristles. The wings are of mean length, the first quill-feather rather shorter than the second and third, which last are nearly equal, and the longest of all; tail rather short, and in general slightly forked; the tarsi slender and short; claws curved and acute; the hind toe tolerably strong, with the sole broad.

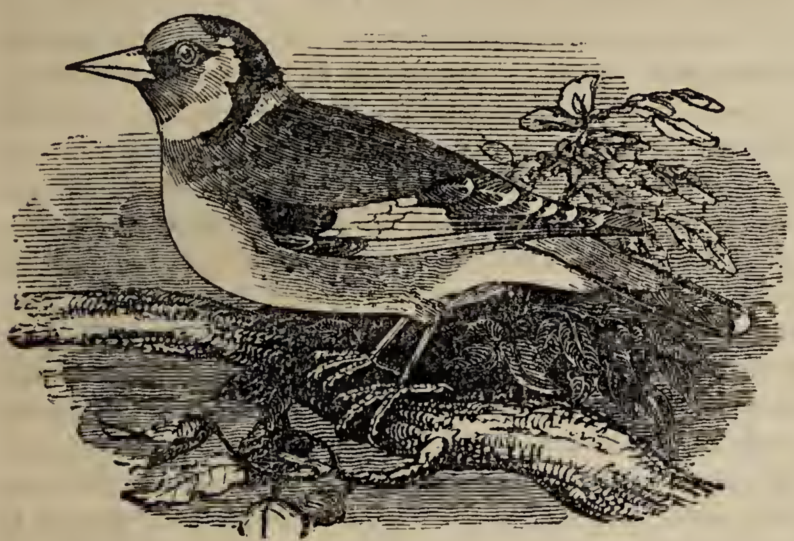
There are two principal modifications of this form, independent of the connecting links which, as is usual, intervene between this and a few other nearly allied divisions. These are distinguished by a slight diversity of form and habit, and by a different style of colouring. The species of one, which is exemplified in the common goldfinch of this country, are what are popularly termed *Goldfinches;* those of the other, which are far more numerous, and of which the common aberdevine siskin (see ABERDEVINE) may be cited as a typical example, are generally denominated *Siskins*.

The colours of the former are gay and brightly contrasted, having the back and under parts uniform spotless brown, shading off into white, or to a paler tint; the wings black marked with white and brilliant yellow, and the head richly adorned with crimson or scarlet, and in some species also with black. The sexes are very similar, and their plumage is altogether more tropical; and after the autumnal moult, they have no deciduous terminal edgings to their feathers. Their habits, also, are less arboreal, the different species passing their time nearer the ground, and subsisting chiefly on the seeds of thistles, and various other composite plants, whence, indeed, is derived their generic appellation *Carduelis* (from *Carduus*, a thistle). They are birds of the low country, and those resident throughout the year, familiar in their manners, building their exquisitely constructed nests in our gardens and orchards, and cheering us, winter and summer, with their sprightly, animated, and pleasing songs.

The siskins, on the other hand, are inhabitants more of the northern pine-forests, and of the more elevated districts in tropical parts, whence they descend in winter, and straggle in flocks over the low country. The character of their plumage corresponds; the hues of the more typical species are not so bright, and the feathers are in winter fringed with terminal edgings, which gradually disappear at the approach of the breeding season. Their wings, as might be anticipated from their more migratory habits, are longer in proportion than in the true goldfinches, and their bills are not drawn to so acute a point. We might from this safely infer that there is a difference in the general character of their food, and we find, accordingly, that they subsist almost entirely upon the seeds of various trees, our British siskin chiefly on those of the alder and birch. They appear to nidificate mostly about the margins of pine forests, at a considerable height from the ground, and the main colour of their plumage is always greenish yellow, brightest in those species which approximate most to the goldfinches, and more or less marked in the others with spots and streaks of dark-greenish brown, or dusky; the males are much brighter in their tints than the other sex, and are generally upon the crown of the head black, and this hue, in one or two species, extends over the whole head and geat part of the neck.

Deciduous terminal edgings to the new plumage, which is acquired at the general moult, in autumn, may be observed upon the throat and upper parts of very many of the smaller birds, but chiefly among the members of the finch family (*Fringillidæ*), and of certain divisions of the starling, thrush, flycatcher, and warbler families. These edgings are merely a continuation of the barbs of the feathers, and are, in many instances, of precisely the same texture, although generally of a rather warmer and more downy nature; they are usually of a pale dusky, or whitish hue, and, as may be often observed in the snowfleck, and sometimes in the bramblefinch, are very apt to become quite white when much exposed to intensely cold weather. In many cases they even entirely conceal the true colours of a bird's plumage, so that, in the spring, after they have disappeared, it would seem to a superficial observer that a general moult had taken place; and instances are not wanting in the books where such birds have, in consequence, been described to change their plumage twice in the year. When this fringe joins the ends of the feather, that is, at the extreme points of junction where the two colours meet, its texture is always considerably finer and weaker, so that, if we were to pull one of the little plumelets, or barbs of the feather, it would infallibly break at this place. Now, a feather, so long as it remains attached firmly to the skin, is part of a living structure, and a circulation takes place within it; but its vessels are exceedingly minute, and the action within them is very apt to be obstructed, more or less, by whatever affects the general health of the body, and this is always immediately shown by the diminished lustre of the tints of the plumage, which consequently affords an excellent test by which to judge of a bird's state of health. It would seem, however, to judge from the always comparatively dead appearance of the winter edgings, that this circulation is never very complete beyond the narrow part which joins the fringe to the extremities of the back; and when, in the vernal season, the action within the feather is either much increased, or the nature of the circulating fluids become changed, as is indicated by the very great increase of lustre, and not unfrequently decided change of hue which takes place at that season, the pores of the narrow connecting parts appear to be finally obstructed, and the edging, in consequence, dies and rubs off; and the brighter colours beneath, which had hitherto been concealed by these dusky fringes, become gradually exposed to view, until the bird becomes altogether in what is commonly termed "its summer plumage."

The very obvious purpose of this structure is to assist in preserving the bodily heat, and we see in it not only an additional supply of clothing for the winter months, but also a *hue* better calculated than that beneath it, both for preventing the bird's heat from radiating, and for concealing it, whilst the leaves are off the trees, from the observation of its enemies. We see also both these objects even further effected by extreme cold in the assimilating of the hue of this additional covering to the tint of the snow and frost; and yet, as white would be a conspicuous, and therefore a dangerous dress, before the snow was upon the ground, we find that the snowfleck (*Plectrophanes nivalis*), and one or two other species, which have much white upon their concealed, or summer plumage, have this actually covered in the autumn with dusky or brown edgings, which, however, have a tendency to become white whenever the weather shall be sufficiently cold to render this change a protection; and here, therefore, we have another, and a very striking instance, of the adaptations of the hues of animals to the colour of their natural haunts. It is worthy also of remark, that the young birds of the preceding season, which, of course, are comparatively tender, have their first winter plumage much more thickly covered with these deciduous edgings than those birds have which have moulted more than once, insomuch that they may easily be thus distinguished; and it may be also observed, that a black plumage, which, of all others, is the colour which most radiates heat, is more frequently thus concealed and fringed than any other colour. We do not mean to assert that *all* black-coloured birds have these terminal winter edgings to their feathers, but it certainly often happens, among species that are very nearly allied, that those which have partly black plumage are thus fringed, whilst others, which are grey or brown, are not. Thus the whinchat, and the common grey flycatcher, have never any edgings to their feathers, whilst the stonechat and the field flycatcher, the plumages of which are on the upper parts black, have; and the red bunting, which is the only British *Emberiza* with a black head and throat, has these parts much more thickly edged in winter than any of our other species. Again, the common robin is never thus edged in winter, whilst the different redstarts, which, physiologically, are very nearly allied to it, but are all of them more or less covered with black plumage, have the new feathers which they acquire at the autumn moult, in some cases almost wholly concealed by brownish tips.



Carduelis.

To return, however, now to the true goldfinches, which, unlike the siskins, have no additional covering to their plumage in winter. What more we have to say of them can be better introduced when giving an account of the different species. Perhaps the most beautiful of the whole genus is the common European goldfinch (*Carduelis elegans*), o which it has been well said, that elegance of form and beauty of plumage, docility of disposition, and sweetness of song, together with its natural hardiness of constitution, all combine to render it a general favourite, and it only requires to be brought from a far country, and to be sold at a high price, to be one of the most choice favourites of amateurs, and to supersede almost every other pet which luxury has imported from foreign parts. Happy for it, however, if its abundance could thus procure for it the neglect of bird-*fanciers;* but the fact is, it is a real matter of wonder how, amid the ceaseless persecution from which it suffers, after the many thousands which are annually captured by the wholesale mode with clap-nets and call-birds, and by various other contrivances and devices, that their numbers are not very considerably on the decline, that they should still be found, year after year, so numerous, so common as they always are. The species abounds in all parts of Europe, with the exception of mountainous districts, from the north of Sweden to the Mediterranean ; and they would in one year be quite common even in the immediate vicinity and environs of our large cities, if the bird-catchers would but suspend their operations for so long a period.

This beautiful finch is so well known, that a description of it is hardly necessary. The bill is pale flesh-colour, with a blackish tip, and continues to increase somewhat in size for two or three years ; the forehead and throat are bright crimson ; the cheeks, ear-coverts, and lower parts of the neck, white; and the occiput and nape of the neck are glossy black. The whole upper parts, with the sides of the breast, are of a bright and deep yellowish brown ; a little above which, on the breast, is a pale band across of the same colour ; remainder of the under parts white, shading into brown. The wings black, with the greater coverts, and basal half of the quills, bright gamboge yellow; the other half black, with a white spot at the tips. Rump whitish; six middle-tail feathers black, with white-pointed tips; the remainder also black, with a large oval white spot, occupying the middle of the inner webs. Legs and toes pale brown. The female is very similar, but her colours are not quite so brilliant; there is no difference in her markings from those of the male. In both, the browns of the plumage become much paler towards the approach of the breeding season, at which time the crimson of the head changes to scarlet, and the yellow on the wings increases in brilliancy; these changes, however, do not take place in captivity. The young, in their nestling plumage, are called by the bird-catchers *grey-pates;* they have then no black and red upon the head, and the plumage all over is streaked longitudinally, like that of a linnet; the wings and tail alone resembling the adult birds, the feathers of which do not appear to be changed until the second autumn.

The goldfinch is very partial to orchards and gardens, and shrubberies, especially if they are ill kept, as its principal food consists of the seeds of various weeds which grow chiefly in such situations; those of the different thistles, the burdock and the dandelion, are its favourite food, as well as the oily seeds of many of the cruciform plants. To obtain the former, it may be commonly observed clinging in various constrained and grotesque attitudes, often with the head downward, whilst the *pappus*, or vegetable down is made to fly in all directions; the bird reminding us, by its positions, of the titmouse tribe, which it further resembles in the habit of holding food with the foot, whilst pecking at it with the bill; a habit which is common to all the species of *Carduelis.* The goldfinch also feeds much upon various green leaves, more particularly on those of chickweed and groundsel, and it will sometimes sit and pick off the aphides from a plant with great assiduity; but it never feeds on insects in the manner of the chaffinches and sparrows, and, in confinement, it invariably rejects every thing of the kind. It is also very partial to the unopened blossoms of furze, and to the flowers of various other plants.

Its song, which may be heard at almost every season of the year, and as cheerily in the midst of a November fog as in the brightest sunshine, is brisk and lively, continuous, well kept up, and extremely musical and cheerful; and its common chirrup and call-notes are more pleasing than those of most other birds. " They seldom," as is observed by a distinguished naturalist, " alight on the ground, unless to procure water, in which they wash with great liveliness and pleasure; after which they pick up some particles of gravel and sand. So fond of each other's company are they, that a party of them soaring on the wing, will alter their course at the call of a single one perched on a tree. This call is uttered with much emphasis; the bird prolongs its usual note without much alteration; and as the party approaches, erects its body, and moves to the right and left, as if turning on a pivot, apparently pleased at showing the beauty of its plumage and elegance of its manners."

The goldfinch's nest is a very beautiful structure, generally situate in the fork of an old lichened fruit tree, and occasionally in hawthorn hedges; it is mostly described to be lined with down of the different thistles, although thistles are very rarely even in flower at the time the goldfinch builds. Grahame is more correct when he says—

> "The goldfinch weaves with willow-down inlaid,
> And cannach tufts, his wonderful abode;
> Sometimes suspended at the limber end
> Of plane-tree spray, among the broad-leaved shoots,
> The tiny hammock swings to every gale;
> Sometimes in closest thicket 'tis concealed,
> Sometimes in hedge luxuriant, where the briar,
> The bramble, and the plum-tree branch,
> Warp through the thorn, surmounted by the flowers
> Of climbing vetch, and honeysuckle wild."

It is of very elegant construction, composed on the outside of lichens, moss, and dry grass, smoothly interwoven with wool, and very warmly lined with a mixture of the last-named substance, hair, and the seed down of the willow. The eggs are four or five in number, of a bluish-white, with a few small orange-brown spots, chiefly at the larger end.

Like most other birds of this family, goldfinches associate after the breeding season in flocks, and traverse the open country; these, however, are never very numerous, their societies rarely exceeding twenty in number; they are in winter always wandering from place to place, often fly at a considerable height from the ground, and always against the wind; but their course is ever instantly arrested by the call of a single one from below. The same may be observed in all our native finches, and this call-note may perhaps be an invitation to food, though more probably it is merely expressive of its propensity to join in company. It is by means, however, of the wild birds being so readily attracted by this call, that so very many of them are taken by the bird-catchers.

Goldfinches are not generally subject to vary much in plumage, but individuals are occasionally taken with the throat white, and sometimes with a white spot on each side of this; these are termed by the bird-catchers *cheverels*, and are often sold at a high price. This species also is very frequently paired with the domestic canary finch, with which it readily breeds, and the mixed produce are commonly termed *goldfinch-mules* or *canary-goldfinches;* the hybrids preserve generally the markings of the goldfinch, with the yellow tint of the canary; and their song most resembles that of the former, but is much more powerful; they readily breed back with either of the parent species, but it does not appear that two of these hybrid birds will ever propagate together.

Among the different groups of finches (*Fringillidæ*), there is a remarkable diversity in the mode of bringing up the young; in the chaffinches, the sparrows, and one or two other divisions, these are wholly fed upon insect food; whereas in the grosbeaks (*Coccothraustis*), the goldfinches and siskins, the linnets, and the different canary finches, they are entirely brought up upon semi-prepared vegetable diet, ejected from the craws of the old birds. This difference is not, however, so important, but that species from each group will sometimes, in captivity, breed together; the writer of this has seen a hybrid production between the domestic canary bird and the common chaffinch.

Hybrid animals, it may not be amiss here to remark, are never produced by two animals both in a state of nature, but are invariably, either directly or indirectly, brought about by man's influence; that is, by the unnatural condition into which at least one (the female) parent had been placed by the direct agency of man. Some cases to the contrary have been mentioned, but they are exceedingly dubious and questionable; and the assertion may very safely be adhered to, that not a single instance rests upon what may be considered conclusive evidence, or satisfactory foundations. For the details, however, of this subject, we must refer to the article HYBRIDS.

There are two or three species of goldfinch, very similar to that of this country, especially one which inhabits the slopes of the Himalaya. This differs a little in the markings, and it has no black upon the head; its under parts, also, are of a more uniform pale brown than in our bird; but its general appearance, and most probably its habits, are extremely similar. There is, indeed, a very remarkable resemblance between a great many of the birds of the Himalaya mountains, and those which inhabit Europe; the same general types of organisation seem to prevail there as with us, but intermixed with a great variety of splendid tropical forms. We find there some remarkable counterparts, as we may term them, of the European jay, green and black woodpeckers, nutcracker, blackbird, great titmouse, nuthatch, and a host of others, much more similar to our species than any which are elsewhere known; yet all these are sufficiently well characterised to leave no doubt of their being separate and distinct species. Of these, one, and not the least remarkable, is the Himalaya goldfinch.

AMERICAN GOLDFINCH (*Carduelis luteus*). This is the *Fringilla tristis* and *Carduelis Americanus* of different authors, neither of which terms are very appropriate, not being sufficiently exclusive; *tristis* refers to the dull appearance of its winter dress, although its summer garb is very bright and showy. The species is intermediate between the goldfinches and siskins; having the habits and general proportions of the former, with the plumage and yellow colour of the latter, but much brighter than in the more typical siskins. Its summer plumage is a bright lemon yellow, fading into white about the rump; the crown of the head black, as are also the wings and tail, the former of which are edged and tipped with white. The female is of a dull olive-brown, marked with dull white, and yellowish; and the male, in winter plumage, is very similar. This species is said to moult twice in the year.

Its habits, as described by Wilson and Audubon, appear exactly to correspond with those of the common goldfinch of Europe. Wilson says, "They build a very neat and delicately formed nest, which they fasten to the twigs of an apple tree, or to the strong branching stalks of hemp, covering it on the outside with pieces of lichen, which they find on the trees and fences; these they glue together with their saliva, and afterwards line the inside with the softest downy substances they can procure. The female lays five eggs, of a dull white, thickly marked at the greater end; and they generally raise two broods in a season. The males do not arrive at their perfect plumage until the succeeding spring; wanting, during that time, the black on the head, and the white on the wings being of a cream colour. In the month of April they begin to change their winter dress, and before the middle of May, appear in brilliant yellow; the whole plumage towards its roots is of a dusky bluish black.

"Its song resembles that of the goldfinch of Britain; but is in general so weak as to appear to proceed from a considerable distance, when perhaps the bird is perched on the tree over your head. I have, however, heard some sing in cages with great energy and animation. On their first arrival in Pennsylvania, in February, and until early in April, they associate in flocks, frequently assembling in great numbers on the same tree to bask and dress themselves in the morning sun, singing in concert for half an hour together; the confused mingling of their notes forming a kind of harmony not at all unpleasant."

Sir W. Jardine well remarks on this, in a note to his edition of Wilson's work, the resemblance which subsists between the habits of the different *Carduelcs* and those of the true linnets (*Linaria*), "Every one who has lived much in the country, must have often remarked the common European linnets, in the manner above described of the American goldfinch, congregating, towards the close of a fine winter's evening, perched on the summit of some bare tree, pluming themselves in the last rays of the sun, chirruping the commencement of their evening song, and then bursting simultaneously into one general chorus; again resuming their single strains, and joining, as if happy, and rejoicing at the termination of their day's employment." M. Audubon has remarked the same trait in their manners, and confirms the resemblance of the notes of the American and European goldfinches. "So much does the song of our goldfinch resemble that of the European species, that whilst in France and England, I have frequently thought, and with pleasure thought, that they were the notes of our own bird which I heard."

Wilson continues: "About the last of November, and sometimes sooner, they generally leave Pennsylvania, and proceed to the south; some, however, are seen even in the midst of the severest winters. Their flight is not direct, but in alternate risings and sinkings; twittering as they fly, at each successive impulse of the wings. During the latter part of summer they are almost constant visitants in our gardens in search of seeds, which they dislodge from the husk with great address, while hanging, frequently head downwards, in the manner of the titmouse. From these circumstances, as well as from their colour, they are very generally known, and pass by various names expressive of their food, colour, &c., such as thistle-bird, lettuce-bird, salad-bird, yellow-bird, &c. * * * They are easily familiarised to confinement, and feed with seeming indifference a few hours after being taken."

The American goldfinch, it would appear, will not pair so readily with the canary-finch, as the European species does. There are instances of their being kept for many years together, without either showing any disposition to breed. A few cases, however, have occurred of their producing hybrids.

Birds of this species were seen by Mr M'Kenzie, in his route across the continent of North America, as far as lat. 54°; they are numerous in all the Atlantic states north of the Carolinas; abound in Mexico, and are found also in great numbers in the Savannahs of Guaiana. A species pretty closely allied to this is the

Black-headed or Olivarez Siskin (*C. Magellanica*), which also much resembles the aberdevine siskin of Europe; but may readily be distinguished from all its congeners by having the head entirely black. This species is said to sing finely, but there is nothing very peculiar in its habits to warrant a particular description. It inhabits the greater part of South America.

The aberdevine siskin (*C. spinus*), has been already noticed in its alphabetical situation in this work; and the general habits of the true siskins are there pourtrayed. Another European species, the

Venturon siskin (*C. citrinella*), approximates in form to the canary birds. The bill is rather short, the feet flesh-colour, the plumage of the upper parts yellowish-green, streaked with brown; the under parts and rump greenish-yellow, brightest about the breast; the quill and tail feathers blackish, with greenish edges; tail forked. The female bird is less spotted, and the general shade of colour is lighter.

The venturon siskin is a pleasing songster, and much sought after in the countries it frequents; has been thought by some to be the wild stock of the Canary bird, which, however, it is not. It is very common in many parts of the South of Europe, frequenting the lower slopes of mountainous districts, especially in Italy, Greece, Turkey, and along the borders of the Mediterranean; it abounds in Switzerland and in the Tyrol, but is rare and accidental farther to the northward. The nest is usually situate in mountain pine forests, and contains from three to five whitish eggs, speckled more or less with dull brick-red. This species breeds readily with the Canary.

The Chinese goldfinch, or siskin (*C. Sinensis*), is a species very common in the Celestial Empire, and in many of the eastern parts of Asia; not rare in some districts of the Himalaya. This bird is intermediate in form and habits between the true goldfinches and some of the smaller grosbeaks (*Coccothraustes*), of which the common green grosbeak (*C. chloris*), or greenfinch, as it is termed, of this country, may be cited as an example. There are several other true siskins inhabiting North and South America, the characters of some of which are not as yet very satisfactorily made out, which arises chiefly from their having hitherto been met with only in winter plumage. Two of these are winter visitants of the United States, namely,

The Pine siskin (*C. pinus*). "This little northern stranger," says Wilson, "visits us in the month of November, and seeks the seeds of the black alder on the borders of swamps, creeks, and rivulets. As the weather becomes more severe, and the seeds of the *Pinus Canadensis* are fully ripe, these birds collect in larger flocks, and take up their residence, almost exclusively among these trees. . . . . . Early in March they disappear, either to the north or to the pine woods that cover many lesser ranges of the Alleghany. While here, they are often so tame as to allow you to walk within a few yards of the spot where a whole flock of them are sitting. They flutter among the branches, frequently hanging by the cones, and uttering a note almost exactly like that of the" American "goldfinch. I have not a doubt but this bird appears in a richer dress in summer in those places where he breeds, as he has so very great a resemblance to the bird above mentioned, with whose changes we are well acquainted." Its winter plumage is very like that of the European aberdevine siskin, only the crown of the head is not black. The writer of this article once observed several pairs of these birds, and of American goldfinches, in the shop of a bird dealer in London. The other North American species is,

The Arkansan siskin (*C. psaltaria*). This was discovered by the naturalists who accompanied Major

Long's expedition; and Say, who wrote the zoological notes to the Journal, observes, "A very pretty little bird was frequently seen hopping about in the low trees or bushes, singing sweetly, somewhat in the manner of the American goldfinch. The tints and the distribution of the colours of its plumage resemble, in a considerable degree, those of the autumnal and less brilliant vesture of that well known species. It may, however, be distinguished, in addition to other differences, by the black tips of its tail-feathers, and the white wing spot." The Arkansan siskin inhabits the country near the base of the Rocky Mountains, south of the river Platte; and may probably be also found in Mexico. It is suspected that the Mexican siskin (*Fringilla Mexicana*) of Gmelin, and also the Black Mexican siskin (*F. Catotol*) of the same author, are referrible to the species in different states of its plumage.

Many of the smaller finches, but more especially the group to which all the little birds we have been just describing appertain, have long been celebrated for their docility, and, consequently, they are great favourites with bird-fanciers, by whom they are often doomed to undergo a severe, tedious, and cruel discipline. The feats they have been gradually trained to perform are almost incredible. Mr. Syme, in his "History of British Song-Birds," when speaking of the Sieur Roman, who some years ago exhibited a number of canaries, goldfinches, and linnets, wonderfully trained, relates, that "one appeared dead, and was held up by the tail or claw without exhibiting any signs of life; a second stood on its head with its claws in the air; a third imitated a Dutch milkmaid going to market, with pails on its shoulders; a fourth mimicked a Venetian girl looking out at a window; a fifth appeared as a soldier, and mounted guard as a sentinel; and the sixth acted as a cannoneer, with a cap on its head, a firelock on its shoulder, and a match in its claw, and discharged a small cannon. The same bird also acted as if it had been wounded. It was wheeled in a barrow, to convey it, as it were, to the hospital; after which it flew away before the company. The seventh turned a kind of wind-mill; and the last bird stood in the midst of some fire-works, which were discharged all around it, and this without exhibiting the least symptom of fear." These astonishing feats were repeatedly performed before hundreds of persons; and one is at a loss at which most to wonder, that irrational beings should be capable of being thus trained, or that beings who consider themselves rational should so patiently and cruelly waste their existence in drilling these unfortunate little creatures into submission.

Some naturalists have included in *Carduelis* the small finches which are commonly termed canary birds. Of these there are four or five original species, two of which have been multiplied in confinement into a very great number of varieties. We prefer, however, to arrange them as a separate sub-genus of *Fringilla*, under the general designation of *Canaria;* but they may, nevertheless, be introduced here, as they are physiologically very nearly allied to the *Carduelis.*

The general form of the canary is too well known to require a very particular description; it is longer, and not quite so compact as that of the goldfinch, and the bill is much shorter, and more bulky. They are somewhat intermediate between the goldfinches and certain of the linnets (*Linaria*), but have several peculiar characters of their own, and they appear to be more local in their distribution than either of these. We know very little of them in a wild state, as is the case with almost every animal which man has long kept in a domestic condition.

One species at least, which may be denominated the *C. communis*, is very abundant in Madeira, where it was observed by Dr. Heincken, who minutely describes it. The bill is about four lines in length, with the upper mandible dusky, the lower flesh-colour; legs brownish flesh-colour; the forehead, throat, line above and below the eyes, the breast, rump, and lesser wing-coverts, greenish yellow; the scapulars, and large wing-coverts, deeply shaded with the same; the back also similarly, but lightly shaded; abdomen rich golden yellow; remainder of the under parts whitish, marked about the flanks with large longitudinal brown spots; the back of the head, cheeks, back, larger wing-coverts, scapulars, and large tail-coverts, brown-ash, with a longitudinal brown spot down each feather; indistinct and faint about the head; large, dark, and defined on the other parts; the tertiaries, quill, and tail-feathers, brownish-black, with pale ash-coloured edges; the external margin of the first four or five quill-feathers white; of the rest, pale greenish yellow; length, five inches and a quarter; breadth, nine inches; weight, about half an ounce; tail forked. The colours and markings of the hen bird are more dingy and indistinct, and the rump is only greenish-yellow. The young males are very similar to the old female, but have the bill and legs darker; and the young females have no yellowish or greenish colouring.

"It builds," says Dr. Heineken, "in thick bushy high shrubs and trees, with roots, moss, feathers, hair, &c.; pairs in February; lays from four to six pale blue eggs, and hatches five times (not unfrequently six) in the season. It is very familiar, haunting and breeding in gardens about the city. It is a delightful songster, with, beyond doubt, much of the nightingale's and skylark's, but none of the wood-lark's song, although three or four skylarks, in confinement in Funchal, are the only examples of any of these birds in the island." These wild canaries, directly imported from the Canary Islands, may be frequently obtained at some of the London shops, but are sold at an enormously high price.

We know very little of the other species of this group; there may possibly be another sort in the Canary isles. Syme mentions one which he received from St. Michael's, which, he says, sung very like the linnet. There is also a very beautiful species in Brazil, entirely yellow, with an orange-coloured crown. This bird may sometimes be procured alive at the London shops; its chirp much resembles that of the domestic species, but its song appears to be very inferior.

"The Canary bird," according to Bechstein, "was brought into our climate as early as the sixteenth century. Its arrival in Europe is thus described:—A vessel, which, besides its merchandise, was bringing a number of these birds to Leghorn, was shipwrecked on the coast of Italy, opposite the island of Elba, where these little birds, having been set at liberty, took refuge. The climate being favourable, they increased, and would certainly have become naturalised, had not the wish to possess them occasioned their being caught in such numbers, that at last they were extirpated from their new country.

From this cause Italy was the first European country where the canary was reared. At first their education was difficult, as the proper manner of treating them was unknown; and what tended to render them scarce was, that only the male birds were brought over—no females."

CARDUUS (Linnæus). The thistle, an extensive genera of well-known annual and perennial weeds. Linnæan class and order, *Syngenesia Æqualis*, natural order, *Compositæ*. Generic character: scales of the anthodium prickly; receptacle bristly; pappus sitting and downy, falling off. Notwithstanding the hostile appearance and bad character of thistles in general, there are some few of them ornamental, growing to a considerable height, and bearing crimson-coloured flowers. Their use in the economy of nature is not very apparent. None of our domestic cattle, except the ass, relish them, but some of them are nibbled by both hares and rabbits while young and tender. Their seeds form a winter feast for many small birds, and they are the cause of the farmer ploughing much deeper to extirpate them than he would otherwise do, which, though oppressive to himself and his cattle for a time, turn ultimately to his advantage, in having a deeper tilth, and cleaner and heavier crops.

CAREX (Linnæus). A numerous genus of rigid herbaceous and grass-like perennials, mostly inhabiting waste sandy soils, bogs, or marshes. They differ from the common grasses in being monœcious, that is, in having their male and female flowers not altogether in the same calyx, but on different parts of the same plant. Sometimes, but rarely, the carex is diœcious, male flowers being on one plant and females on another. Hence they are not ranked with the true *Gramineæ*, but in the natural order *Cyperaceæ*.

CARINARIA (Lamarck). This singularly elegant mollusc has been considered by many authors a species of the genus *Argonauta*, from which it essentially differs, as the following description clearly points out. The shell is symmetrical, extremely thin, a little compressed, without a regular spire, but its summit slightly recurved backward; the aperture oval and very retired; the substance of the shell is semi-transparent, and of a glossy appearance, and may be at once distinguished from the *Argonauta*, by having a *single* keel, and the apex or spire *never entering the aperture*. It only partially protects the body of the animal, which is lengthened backwards from the nucleus into a true tail, furnished at its extremity with a vertical fin; the head is very distinct, with two long conical tentacula; it has two sessile eyes, the respiratory organs and the nucleus entirely enveloped by a mantle, with lobed edges. In De Blainville's system, this genus is placed in the second class *Paracephalophora*, fifth order *Nucleobranchiata*, first family *Nectopoda*. Three species are known, the *C. vitrea*, so called from its glass-like texture; the *C. fragilis*, from its extreme delicacy; and the *C. cymbium*, or boat-shaped carinaria, which is not larger than a grain of sand, and can only be seen by the aid of a magnifying power; one inhabiting the African seas, another the Mediterranean, and the third, considerably larger, is found in the Eastern ocean.

At one time this mollusc was incomparably rare, and large prices given for it, but one of its species has latterly been more frequently met with. Many specimens are now existing of the shell and its inhabitants, and one beautifully displayed in spirits may be seen in the splendid museum of the Royal College of Surgeons.

CARNASSIERS. The third order into which Cuvier divides the mammalia, or those animals which suckle their young. Though etymologically, this word has very nearly, if not altogether, the same meaning as the old name *carnivora;* and thus it appears as if the same word were applied in two different senses. Yet as the French term is not identical, either in spelling or in sound, with the Latin, and as a better arrangement is obtained by using the one word for a large class, and the other for a smaller division or sub-class of the same, the apparent anomaly of the words is more than compensated by the advantage of the arrangement.

Under the general name carnassiers, Cuvier includes all mammalia, of which the principal food is animal matter; though it is impossible to draw the line with perfect precision, in as much as there are few animals of any class which do not occasionally eat animal matter; and there is perhaps no animal of any class, but which might be made to exist, at least in part, on vegetable matter. But as Cuvier's classification is structural, and allows a considerable degree of latitude as to the use of the structure, it is exceedingly convenient, and at the same time as precise as the nature of the subject will probably admit. The following is a brief outline of his general characters of the class:—

The numerous animals which it comprehends, all have the extremities divided into fingers or toes furnished with nails; and they all have three kinds of teeth,—namely, cutting teeth in the front of their jaws, canines at the middle part, and cheek teeth or grinders behind these.

These animals, however, have no grinding motion like the ruminantia, the greater part of the quadrumana and all animals which live much upon vegetable food. Their jaws have a hinge motion only, that is they close one upon the other, and close very firmly; but the articulation of the lower jaw is so tight that it cannot be moved from side to side. There are considerable varieties in them, arising principally from differences in the cheek teeth. These cheek teeth are of three different forms; sometimes they are nearly flat on their summits, with only low blunt tubercles; sometimes again they have the tubercles more elevated and sharper at the points; and there are still others which have trenchant tubercles, by which means they are adapted for cutting and tearing at the same time. The first of these three forms is adapted for bruising or dividing vegetable matter; and one may observe, that when a dog gets a piece of hard bread, he takes it as far back between his jaws as possible, in order to reduce it to a state fit to be swallowed. The second kind are more exclusively fitted for insect food, which requires not to be chewed or torn, but merely to have its crust, or other tough or hard covering broken, so that the fluids of the stomach may act upon that part of it which is digestable. Those of the third form are adapted for tearing flesh; and in proportion as these predominate, the owner is found to feed more upon the flesh of warm blooded animals, and less upon vegetable matter of any kind.

Their brain, though it is considerably furrowed or convoluted, does not appear to be so well developed as in man, or in the quadrumana; there is no division of bone between the temporal foss and the orbit of the eye; their skull is narrow, and the zygomatic arch is wide and elevated, so as to give room for the powerful muscles which give motion to the lower jaw, the mouth being in most of them the grand instrument in seizing the food, and in all of them the one by which it is more immediately prepared for the stomach. Their food is of a much more nutritious character than that of the vegetable feeders; and their stomachs are in consequence simpler, and their intestinal canals much shorter.

The sense of smelling is described by Cuvier as being the most acute which these animals possess; and some of them have this sense in very wonderful perfection, of which there are remarkable instances in blood-hounds, and other dogs which follow on the scent. Many of them have also very acute sight; and the nocturnal preyers especially are very quick of hearing. These animals, though, as their food is of much more nutritious quality than that of those which feed upon vegetable matter, they require to take less of it, or at all events to take it less frequently, yet requires more address and energy in the capture. The food is endowed with the power of locomotion as well as the feeder, and the prey is endowed with arts and means of escape, as well as the preyer is with arts of capturing.

It must be borne in mind that, in the system of nature, the war which those predatory animals wage on the other races which are their prey, is not a war of extermination, but a war of preservation; and that in a state of nature, the ravages of the lion and the wolf, are as much a part of the system as the browsing of the antelope and the sheep. Hence, in the different powers which these predatory animals possess, in the modes and times at which they use them, and in the increase and diminution of the animals themselves, so that they may be always in the most exact proportion to the necessity which there is for them, we have some of the most beautiful instances of design, some of the most striking proofs that creation and creation's laws have emanated from an all-wise and almighty Creator, which are to be found in any part of the system. No doubt the system is equally perfect in all its parts; but, of course, the more energy is displayed in the working of any part of it, the more forcibly does it draw our attention, and the better is it calculated for enabling those who are just entering upon the study to turn it to the proper account. It would be very delightful here to enter into some details of the structure and the arts of predatory animals, and we are constrained to desist from doing so with no small reluctance and regret; but it is of far too great magnitude for finding a place in a miscellaneous work of moderate dimensions, in which notices of all the kingdoms of nature have to be included. In noticing the subdivisions of the class, in their order in the alphabet, we shall, as occasion offers, throw in a few hints; and we shall restrict the remainder of this article to a list of the families or tribes, into which Cuvier divides this extensive and very interesting order.

Family first, CHEIROPTERA (winged hands). These may be considered as the link in which may be traced, the connexion between the four-handed climbing animals, and the following families of this order. They have still many of the characters of the quadrumana—the pectoral mammæ, the perfect clavicles, the consequent action of the anterior extremities more across the axis of the body than in the direction of it; and thus they are not adapted for progressive motion on the ground; but make their way through the air by means of membranes of flight, put in motion by their anterior extremities. (See CHEIROPTERA and the references from that article.)

Family second, INSECTIVORA (feeders upon small animals, which are seldom of the warm-blooded classes). They are animals of the earth much in the same way that the first family are animals of the air. They live much under ground, and in cold countries they are dormant in the winter. Their bodies are in general flat, and their legs short: the anterior ones being capable of lateral motions from the possession of clavicles. They are all plantigrade, or walk on the soles of the feet. Their cheek teeth all have sharp conical tubercles; and in their incisive teeth some of them bear a resemblance to the rodentia, or gnawing animals. See INSECTIVORA.

Family third, CARNIVORA (animals which are, more or less in the habit of killing other warm-blooded animals, and eating their flesh). There are two divisions of them,—one plantigrade, or walking on the soles of the feet, and another digitigrade, or walking on the toes. They are the animals to which the popular name of "beasts of prey," is given. See CARNIVORA.

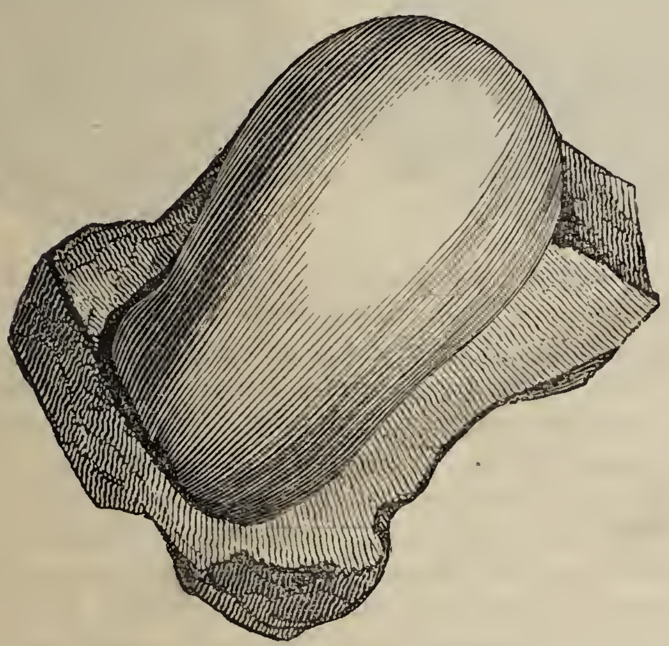
Family fourth, AMPHIBIA (animals which live both in the air, and under water). These animals do not perform the same functions of life in the air and in the water, so as to be equally at home in the one of these, and excluded altogether from the other. There is no known animal that can do this; for though some water animals, both reptiles and fishes are furnished with apparatus with which they can live a short time on land; and there are many land animals which can live a short time in water; yet the water animal cannot bear dry air to come in contact with its gills, neither can the land animal bear to take water into its lungs, however that water may be impregnated with air. The amphibia are all truly land animals in their breathing, and they merely seek their food, and spend the greater part of their time in the water. See AMPHIBIA.

Cuvier adds a fifth family, MARSUPIALIA, or animals of which the female is furnished with an abdominal pouch, into which the young are received, after they have been brought forward a longer or shorter time in an internal uterus. In strict propriety, however, these animals cannot be brought into any of the orders of those mammalia which are without the marsupium. Some of them are carnivorous, others feed on vegetable matter; some browse or nip the green herbage, in a manner not very different from that of ruminating animals, though they are not ruminants; and there are others which, in many of their habits at least, resemble the rodentia, though none of them have the proper rodent or gnawing teeth. Independently of the possession of the marsupium (of which there are many variations as to the degree of its development, and of that of the young when received into it, there are several general characters, which run through the whole of those animals, and seem to require the formation of them into a distinct sub-class of mammalia. See MARSUPIALIA.

CARNELIAN. A mineral forming a sub-species of calcedony. It is the *Sarda* of Pliny, and does not appear to have possessed its present name till comparatively modern times. The principal colour of carnelian is blood-red, of all degrees of intensity;

the dark tints sometimes incline to reddish brown but the paler one pass into flesh-red and reddish white, and also into a colour intermediate between ochre and wax-yellow. It also occurs sometimes milk-white and olive-green. It generally has but one colour; frequently, however, it exhibits concentrically-striped delineations, somewhat resembling fortifications, or red dendritic delineations.

It occasionally occurs in rolled pieces, which appear to have been original balls; sometimes in thin layers, and but rarely in kidney-shaped formations. The surface of the rolled pieces is rough and reddish brown. It is frequently found in fibrous concretions, which are straight, scopiform, closely aggregated, and collected into long and wedge-shaped prismatic and lamellar masses. A very perfect example of the kidney-shaped form of the carnelian is given in the subjoined wood-cut.



The specimen from whence the above figure was taken is of a deep blood-red colour, and the external surface is semi-transparent.

Carnelian is employed to a considerable extent by the jewellers. It is cut into seal-stones, ring-stones, bracelets, necklaces, brooches, and crosses; and figures are often engraved upon it. Artists distinguish three principal kinds of carnelian: the one, named *common carnelian*, varies in colour from white through yellow to red; the second, *sardoine*, displays on its surface an agreeable and rich reddish brown colour, but appears of a deep blood-red colour when held between the eye and the light; the third, named *sardonyx*, is composed of layers of white and red carnelian. In the most esteemed carnelians of the east, the colours are of a uniform tint throughout the mass, without any undulations, and are free from that muddiness to which the European varieties of this stone are so liable. The most highly-prized varieties are the white and red striped, or *sardonyx*, and the blood-red; the next in estimation are the pale red; and the least valuable are the yellow, white, and brown. As it is a softer stone than common calcedony, it is more easily cut, and splinters much less when cutting and polishing; and hence, independent of colour, it has always been preferred by artists to the common calcedony. The finest varieties of carnelian are named by French artists those of the *old rock* (vieille roche), because they are no longer to be found so perfect in colour and transparency. The finest pieces of common carnelian are brought from Arabia, and from Surat in India.

Formerly, carnelians used to be imported from Japan into Holland, and from thence carried to Oberstein on the Rhine, in order to be exchanged for the agates of that country, which were exported to China.

The carnelian was much esteemed by the ancients. Many fine antique engraved carnelians are preserved in collections, and these have been described by Count Caylus, De Geer, and others. The *sardonyx* was cut into cameos, and afforded by far the most beautiful articles of this kind. The finest antique cameo at present known is in the French Imperial Museum at Paris: it is cut in a *sardonyx*, is of an oval shape, and is eleven inches by nine in breadth. It represents the Apotheosis of Augustus.

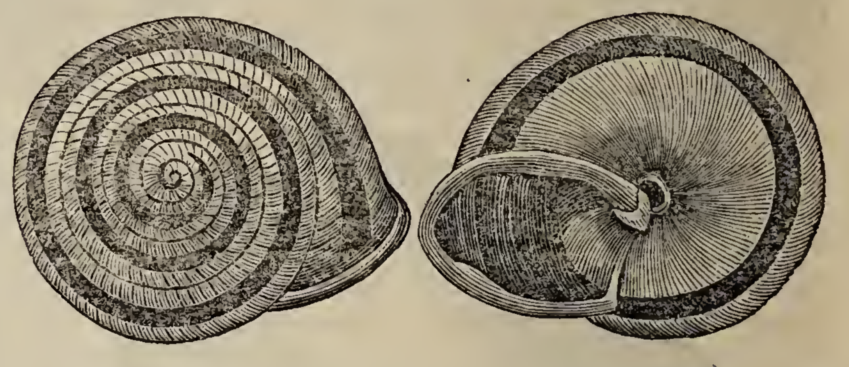
CARNIVORA. The third family of Cuvier's great order of *Carnassiers;* these animals have the teeth peculiarly adapted for wounding and killing, and for tearing, cutting, and bruising flesh. For the first of those purposes, they are provided with four large and long canine teeth, two in each jaw; between those there are in each jaw six incisors in front, the second of which in the lower jaw, is always more deeply seated than the others. Their cheek teeth never have their summits formed into small conical points or tubercles, like those of the animals which feed upon insects. A greater or smaller number of them have always trenchant or cutting edges, or ragged outlines, and are fitted for dividing tough substances. These, and not the canines or wounding teeth, are the proper carnivorous ones, by which the characters of the animals are best ascertained; for there are many vegetable feeding animals which have large and strong canine teeth, with which they can inflict more terrible wounds than many of the carnivora. But these last inflict those wounds only in self-defence, in the reality or the anticipation of danger; and their wounding is indiscriminate as compared with that practised by carnivorous animals. The instinct of those always guides them to select some vital part, or at all events some part which is adapted for causing the death of the prey in the most summary manner. Thus, the aim of the whole genus *canis* is at the throat of their prey; the weasel tribe divide the blood-vessels in the side of the neck, even of animals much larger than themselves, with as much accuracy and neatness as if they had carefully studied the anatomical structure of their prey; and though the larger cats throw themselves on the backs of those animals which they are unable to beat to the ground by the force of their spring, they keep tearing the muscles in those parts, on which this operation is calculated to bring the animal easiest to the ground, where they speedily despatch it by directing their weapons against the vital parts.

If the animals have several of the back teeth with the crowns nearly flat, or only with low blunt tubercles, they can in part prepare the more succulent kinds of vegetable matter for their stomachs; but those which have have few teeth of this kind, prepare such substances with much difficulty and labour. As even those which are best adapted for living upon vegetable food, and live most upon it, have no grinding motion of the jaws, they divide vegetable substances with much more difficulty than those races which have the grinding motion, and the short teeth true molars; and, as the number of comparatively flattened teeth diminishes, the difficulty increases. One case of this gradation may be seen in the domestic dog and cat. The dog is the less carnivorous animal of the two; and as he uses the mouth only in the capture and killing of his prey, he has much more powerful and varied action of the neck. He can divide a portion of tough vegetable matter, as for instance a crust of bread, only by repeated vertical bites; but if he has much labour with the substance, and his hunger is strong enough to induce him to eat it, he may be seen shifting his head, now higher at the one side, then higher at the other, alternately, in order to bring the whole under his teeth; and he also flings the head upwards or downwards, and gives a snap, so that the lower jaw may bite with a momentum, while the substance to be divided rests against the teeth of the upper jaw. The cat has a good deal more trouble in this imperfect mastication, as she cannot snap, and derive advantage from the momentum of the jaw as the dog does; thus with her, the division of hard vegetable food, so as to prepare it for the stomach is no easy matter. All the actions of those animals, with reference to their structures, are eminently deserving of the most careful study, as a highly interesting portion of nature's mechanics, and as eminently useful to man in understanding how to construct mechanical apparatus upon principles at once the most economical and the most efficient. But though we can and do recommend the study, our space will not admit the introduction of the details; we shall, therefore, close with a mere notice of the two leading divisions of this family, or rather sub-order of animals, those divisions are two:

First, Plantigrada; animals which walk on the flat of the foot, or apply the whole length of it to the ground in walking, and thus have the elbow and knee joints, the first from the ground on their march. Those animals, though they have a firmer base, especially when they stand upright, or rest the whole weight of their bodies upon the tarsi of their hind feet, are, in general, much slower in their motions than those which plant only the toes; and if they have much motion they require the two joints of which they have the command in each leg, clear of the ground, to be more free in their motions than they are in those races which have the advantage of an additional joint. The play which is thus required in the femoral bones and the scapulars, gives the animals a loose appearance, as if they were badly put together. They in many particulars resemble the insectivorous division; and many of them are, in part at least, insectivorous; and like those, some of them at least, are dormant during winter in cold climates. See Plantigrada.

Second, Digitigrada; or animals which walk upon the toes, or upon the toes and metatarsal bones; but have the tarsi clear of the surface. From having the ankle joint at their command in walking, in addition to those joints which are used by the former division, their motions are much more lively. This briskness is not confined to the mere motions of the legs, but extends to the spine, which is more elastic in them than in the plantigrades; their shoulders have also a greater appearance of firmness; and they remain active during winter. See Digitigrada.

CAROCOLLA (Lamarck). This genus of molluscs was constituted by Lamarck, from the Linnæan helices, to which, however, it is so nearly allied, that it has been restored by De Blainville to the *C. helix*, of which, in his system, it forms the first division. It is principally distinguished from the helix by the circumference of the shell being constantly carinated or sub-carinated at every stage of its growth; its form is discoid, sub-umbilicated; the lip thickened, and the shell more convex on the lower side than the upper one; the right lip or margin is consequently sub-angular, and frequently toothed within. The accompanying cut of the *Carocolla fasciata* fully points out these distinctions. They are all of them terrestrial shells, and the animal resembles that of the helix so nearly, as to need no separate description. Lamarck describes eighteen species; but a more considerable number is known. They inhabit all parts of the globe, as well in the driest situations, as on the banks of rivers and damp places. The fossil species are by no means so numerous as the recent.



This mollusc is placed by De Blainville in the second class *Paracephalophora;* first order *Pulmobranchiata;* third family *Limacinea.* Many attempts have been made by modern naturalists to subdivide the immense numbers of helices into well-defined groups, in order to facilitate a knowledge of the species: De Montfort commenced the task by forming about ten genera; Oken proposed others; but the Baron de Ferussac has published a magnificent work on terrestrial and fluviatile molluscs, in which a system of classification is pursued, exhibiting deep research and sound reasoning. Unfortunately, the expense attending such works on natural history, closes them to the generality of readers, and renders them more objects of luxury than utility; to obviate which is the study of all enlightened men in the present day, and the great end of the editor of this work.

CARYCHIUM (Müller). Phitia (Gray). A genus of molluscs, forming one of the divisions of De Blainville's and Lamarck's genus *Auricula.* It will be more amply described under the article Phitia.

CARYOPHYLLEÆ. The chickweed family. A natural order of dicotyledonous plants containing nearly thirty genera, and upwards of eight hundred and fifty species. It is closely allied to *Lineæ* and *Frankeniaceæ* as well as to *Elatineæ.*

The essential characters of the order are:—sepals four or five, continuous with the peduncle, at one time free, at another coalescing into a four or five-toothed tube; petals also four or five in number, hypogynous, but occasionally wanting; stamens usually twice the number of the petals, slightly united at their base; anthers two-celled, opening longitudinally; ovary inserted on the top of a pedicel or torus; styles varying from two to five; capsule one to five-celled, and from two to five-valved; placentæ central, in the two to five-celled capsules adhering to the edge of the dissepiments; seeds indefinite; albumen mealy; embryo curved round the albumen; radicle directed to the hilum.

The plants of this order are generally herbaceous, rarely assuming a shrubby character. Their stems are knotty, they are furnished with terminal flowers and opposite entire leaves. They inhabit the temperate and colder regions of the globe, and are found on mountains as well as in hedges and waste places. The few species which exist in tropical countries grow at a great elevation, generally close to the limit of perpetual snow. They are very abundant in Europe and Siberia. According to Humboldt the caryophyllea constitute a seventeenth part of the flowering plants of Lapland, a twenty-second part of those of France, a twenty-seventh of those of Germany, and only a seventy-second part of those of North America.

By De Candolle, the order is divided into two sections, *Sileneæ*, in which the sepals are united into a tube, the petals have elongated claws, and *Alsineæ*, in which the sepals are distinct or only coherent at the base, and the petals are not furnished with claws. The former includes the genera *Silene*, *Dianthus*, *Saponaria*, *Lychnis*, *Agrostemma*, *&c.*; while the latter comprehends the genera *Alsine*, *Stellaria*, *Sagina*, *Spergula*, *Arenaria*, *Cerastium*, *&c.*

The plants of the order are not remarkable for any active properties, being generally insipid. From some of them a volatile oil may be obtained, and a few have been used both medicinally and dietetically. In general they are mere weeds, and are not submitted to cultivation. Most of the species of *Dianthus* and *Lychnis*, however, possess handsome fragrant flowers, and are prized in the garden. They are propagated by cuttings, divisions, and seeds.

The genus *Silene* contains two hundred and seventeen species, ten of which are natives of Britain. *Silene arenaria*, common or Lobel's Catchfly, is a pretty border annual familiar to every one. It grows freely, and has been naturalised in some parts of England. *Silene acaulis*, moss campion, with its beautiful purple flowers, is a great ornament of our alpine districts. A decoction of the root of *Silene Virginicæ* is used in North America as a remedy for worms. The boiled leaves of *Silene inflata*, a very common plant in Britain, taste like peas, and proved of great use in a famine at Minorca in 1685, when the harvest was destroyed by locusts. The leaves are used as an external application in erysipelas.

Dianthus, or pink, is the most showy genus of the order. The elegant little maiden pink, so frequently found on our hills, is a species of this genus. Under it also is included the common Sweet-William, so generally cultivated as a garden flower. *Dianthus Caryophyllus*, clove pink, or clove gilly-flower, is the species whence the name of the order is derived. This plant is found native in Italy, and grows apparently in a wild state on the walls of some old castles in England. It is interesting as giving origin to those beautiful varieties of *Carnation*, so highly valued by the florist. The varieties of carnation amounted to nearly four hundred named sorts in the beginning of the eighteenth century, and since that time they have greatly increased. They have been arranged in three classes, *flakes*, *bizarres*, and *picotées*. Flakes have only two colours, and their stripes are large, going quite through the petals. Bizarres are variegated in irregular spots and stripes, and their colours are not less than three. In the picotées the colours are arranged like a fringe round each petal; they have a white ground, which is spotted with scarlet, purple, yellow, and other colours. New varieties are raised from seed, and are chiefly procured from Germany and Italy. Established varieties are propagated by cuttings or layers. Carnations thrive best in a rich but somewhat sandy loam, and they require to be protected by a frame during winter, and to be covered with an awning when in flower. The flowers of the clove-pink have a pleasant aromatic smell, and a bitterish, somewhat astringent, taste. They are used to give a pleasant flavour and a fine colour to a medicinal syrup.

The leaves of *Saponaria officinalis*, common soapwort, are employed to take out spots of grease. The plant derives its name from the property of forming a saponaceous compound with water, a property possessed by several other plants of the order, more especially *Lychnis dioica* and *Chalcedonica*. The root of the soapwort has a bitterish taste, and has been used in medicine for the cure of gout, rheumatism, jaundice, and other complaints.

Stellaria media, common chickweed, or stitchwort, is a well known weed, which has been used as a pot-herb, instead of spinach, and the seeds of which are eaten by birds. The flowers are upright, and open from nine in the morning till noon, unless it rain. After rain they droop, and continue to do so for several days. This plant illustrates the sleep of vegetables, the leaves approaching in pairs every night and inclosing the rudiments of the new shoots. In this way nature also makes provision for the protection of the young shoots.

Arenaria peploides, sea-side sandwort, grows abundantly on the shores of Britain. It is used in Iceland as an article of food, and forms an excellent pickle. The *Arenaria marina* is also used as a pickle in place of samphire, to which it bears some resemblance.

The berries of *Cucubalus baccifer*, berry-bearing campion, are said to be as poisonous as those of the deadlynight shade.

Spergula arvensis, common spurrey, called *Yarr* in Scotland, and *Pick-purse* in Norfolk, is considered as excellent pasture. It is said to enrich the milk of cows, and to form excellent butter.

CASNONIA (Latreille). An elegant genus of insects belonging to the order *Coleoptera*, family *Carabidæ*, and sub-family *Brachinidæ*, and distinguished by its long and slender neck-like thorax, brown head narrowed behind, antennæ much shorter than the body, tarsi with the penultimate joint bilobed. These insects are of small size, not exceeding one-third of an inch in length, they are inhabitants of the warmer climates of the globe, where they reside, according to M. Lacordaire, who observed their habits in South America, in moist places on the margins of brooks. They run very quickly, soon take flight, and when on the wing, are easily mistaken for small tiger beetles (*Cicindela*). They are generally prettily variegated. We have adopted the generic name given above, being employed by most authors, although we agree with Messrs. Audouin and Brullé in considering that the long previously proposed name of *Colliuris* of De Geer (which has been improperly used for a genus of tiger beetles) ought to be restored to this group.

CASSICUS (so called because, in the most typical species, the crest bears some resemblance to the feathers worn by a *cazique* or Indian chief). A genus or rather family of birds, placed by Baron Cuvier in the conirostral family of his order *Passeres*; but which, in a natural arrangement, would require a different place in the system. They are, in fact, omnivorous birds, bearing more resemblance to the starling, at least in their manners, than to almost any other British birds. They have also been named and described as *Orioles*, but they differ much more from the orioles, properly so called, than they do from the starlings, or even from the larks. The orioles have a notch in the bill, and thus come under the dentirostral division. But in truth, the presence or the absence of this same notch gives us very little information as to the feeding or the other habits of the birds; for some of those which have not the notch, are as insectivorous as those which have it; and some which have it feed as much on vegetable substances as some which have not. Thus there are, in this part of the system, difficulties which we do not appear to have, at present, any means of overcoming; and thus, as the arrangement of Cuvier is, to a very considerable extent, structural, and as it is simple, and serves as an index to the species, perhaps the wiser plan is not to attempt breaking in upon it by minor emendations.

These birds have a large bill, of a perfectly conical shape, very thick at the base, and remarkable pointed at the tip. Their nostrils are small and round, placed laterally in the bill near its base; and the tomia or cutting edges of the mandibles, form a broken or angular line as in the bills of starlings. They are all natives of America, inhabitants of the woods, or rather of their margins. In their manners they very much resemble starlings, assembling in flocks and building their nests near to each other. Those nests are often suspended from the extremities of branches of trees, and constructed in a laborious and even elegant manner. They live indiscriminately upon insects and upon the seeds of plants. In search of the latter, they commit very serious depredations on the cultivated fields, in return for which they make less amends than most races of similar habits, as the flesh is of no value for food, being tough and bitter, like that of the crow family; and having at the same time a disagreeable musty flavour.

There are several divisions or sub-genera of them, among which there are considerable varieties in colour, size, and other external appearances; but their habits and more essential characters are all very much alike. These divisions are, *Cassicus*, *Icterus*, *Xanthornus*, *Oxyrhinchus*, and *Dacnis*; and of most of these there are numerous species.

Cassicus. The distinguishing character of this division is the upper mandible of the bill extended upward and forward, so as to occasion a considerable notch or blank in the plumage of that part. The members of this division are also larger than those of the others. The following are a few of the species:—

Cassicus bifasciatus. This species, which is the crested oriole of British ornithologists, has two reddish bands on its black bill, from which it gets the name of bifasciatus, or two-banded. The general colour is black, but the long linear feathers of the crest, the lower part of the back, the rump and the vent feathers are chestnut; and the two lateral feathers of the tail are yellow. The colours of the female are not so bright as those of the male. This is considerably the largest of the tribe, though it varies considerably in size in different districts. Its length is from eighteen to twenty inches, and the extent of its wings from twenty-seven to thirty. But though a large bird it is of no value, as its flesh smells so rankly of musk as to be very offensive. It is very generally distributed over the lower and warm parts of South America, being found in Guiana, in Brazil, and Paraguay. When this bird utters its cry, which is very varied and singular, bearing some resemblance to the word "yapou," which is its name in some parts of America; it is usually perched on an inclining branch, with its body stretched out, its head lowered, its wings half extended, and its whole frame in a state of apparent excitement. In most places, these birds are met with singly or in pairs, but in some instances a hundred or more assemble in a flock, flying and working in concert, keeping time with each other with each stroke of their wings, and occasionally all halting at the same time on the tops of trees to rest themselves. In the time of nest-building and breeding, they follow a law which is very general, and which might be expected to be very general in those places of tropical climates, where there is little difference of seasons, and food can be obtained all the year round. There is no particular breeding season, broods being met with at all times of the year. They always breed in trees, and construct hanging nests of rather a curious description. They do not build in the thick forests; for their food is obtained not from the tall

C. bifasciatus.

trees, but from the lower vegetation or the ground, though they readily eat the fruit of several of the passion-flower tribe, and other climbing plants. The trees which they select are those in which enemies to their young are least likely to be concealed, or to which they appear to be least accessible. Trees about thirty or forty feet in height, of a smooth stem, before they put out any lateral branches, and of which the lateral branches are long and apart from each other at the extremities, are the favourites of the birds. Appended to the branches of such a tree, it is by no means uncommon to meet with from half a dozen to a dozen of their nests dangling freely in the air. The nest is about a yard in length, small at the top, but increasing in size to about ten inches in diameter at the bottom, where it terminates hemispherically. Such a fabric requires no small labour. It is the joint manufacture of the male and female, who make the principal part of it of the fibres of a species of aloe, which are very tough and firm; and with these they intermix small rushes and vegetable fibres, until the structure is very firm, and not un-handsome. The entrance to it is lateral, but near the top; and the lower part is bedded with the thickest rushes they can procure. The more delicate parts of the fabric, both in the nest of this species and of some of the others, is formed of the fibres of a parasitical epidendron, *Tillandsia usneoides*, popularly called "old man's beard." These fibres are very tough and flexible, and similar in appearance to the long hairs of a horse's tail. The extreme fineness of the point of the bill, and the firmness of the substance of the mandibles, enable the birds to weave these fibres more compactly together than could be easily done by a basket-maker. This singular nest is very firmly attached to the branch from which it is suspended; and notwithstanding the extent to which it is rocked when the wind blows, its depth is such that neither the eggs or young sustain any injury. The eggs are three in number, and the mother feeds the young carefully with worms and larvæ. It is probable that the same pair may have two or three broods in the same year. These birds, and indeed all the family, agree with omnivorous tribes generally in being very easily tamed, in being very general and hearty feeders in their captivity, and in being easily taught to imitate the sounds of other animals, and to articulate words.

Cassicus hemorrhöus. This is a smaller species than the former, but it is much more handsome; and though its colours are far from being so gay as those of many of the feathered inhabitants of tropical countries, it is still a very handsome bird. Its general colour, like that of the former, is black; but instead of the black fading into chestnut brown, it is in many places glossed with green reflections; and the lower part of the back, the rump, and the vent, are crimson. This species is (as indeed the whole are, though the contrary has been stated with regard to some of them) a native of the American continent only, and is most abundant in Guiana. Its nest is constructed in a manner similar to that of the former species; indeed they all build pendulous nests; but it is not so long, and is constructed with a curved entrance, it is usually on a branch which hangs over the water. This nest is only about half the length of the former one, but the internal cavity, in which the eggs and young are lodged, is nearly of the same dimension.

Cassicus icteronotus. This species has been called the Persian oriole; but the name is improperly applied, as this, like the rest of the family, is an American bird; and we may add, that there are no true orioles in America, all the birds on that continent which have been so named belonging to one or another of the sub-genera of cassicus. The present species is black, with the lower part of the back, a spot on the wing coverts, and the base of the tail feathers, yellow. From these colours, it has sometimes been called the black and yellow oriole; and it is the *grand troupiate* of D'Azzara, though it does not belong to the troupiates of Cuvier, which form the sub-genus *Icterus.* The male is about the size of a blackbird; the female is a little larger, but both the black and the yellow are duller.

This is a very social or gregarious species. Numbers of them assemble in the same places, after the manner of rooks in this country; and indeed more closely, for there are sometimes as many as three hundred, or four hundred nests, in the same tree. The nest is about the same size and shape as that of the second species; but if possible more elaborately formed. The eggs are dull white, marked with small dots of a pale brown colour; and there are at least three broods in the year. These birds resemble rooks in another habit besides their social disposition, they are exceedingly clamorous, but the sounds which they utter are not so monotonous as those of the rook. They have a sort of whistle, and also a warble, which is not unpleasant; and in addition to these they are apt to imitate every sound which they hear, such as the notes of other birds, the barking of dogs, and the laughing of human beings. Thus, in the places which they inhabit, they keep the margins of the forests quite alive with their noise. They are very easily tamed; and, when well treated, they are very amusing, as they can be taught to articulate words, to whistle tunes, and to imitate a great number of sounds.

Besides these, there are many other species of this genus; and perhaps there are many more in the forests which have not been noticed. Among the known ones we may mention *C. viridis*, with the bill orange, the crest, of which the feathers are very long, olive-green, and the wing-coverts with brown tips; *C. nigerrimus*, with the bill and body wholly black; and *C. ater*, black, with metallic reflections, and the feathers of the nape produced into a sort of ruff. The first and second of these species have been described as inhabiting Brazil, and the third Paraguay; but it is probable that they are all common to various parts of South America.

Icterus. The chief distinction between this sub-genus and the former, consists in the form of the bill, the portion of which that extends on the forehead being smaller, and the culmen of the upper mandible arched. There are a great many species, too many indeed, and differing too little in their manners from those of the preceding sub-genus, for it being necessary to give any particular account of them. They are all natives either of the warmer parts of the American continent, or of the West India islands. The names of the best known ones are as follow:—

I. varius: black, with the sides of the breast, the under part of the body, the rump and the margins of the wings, chestnut. All the colours very glossy, and varying in tint as the light falls upon them. *I. chrysopterus:* lesser coverts of the wings yellow, the tail wedge-shaped and black; the bill straight, slender, very sharp at the tip. This species is found in Paraguay, and inhabits more deeply in the woods than some of the others. *I. capensis:* is an inhabitant of the warmer parts of North America, and not of Southern Africa, as the trivial name would lead us to suppose. This is a small species, not exceeding seven inches in length. *I. flavigaster:* about eight inches in length, black, with the lesser coverts, the middle of the belly, and the vent feathers yellow. *I. chrysocephalus:* a native of Brazil. The general colour black; and the forehead, crown, sides of the hind-head, feathers on tibiæ, and lesser coverts, yellow; the bill rather long, slender, pointed, and considerably arched. *I. versicolor:* black, with bronze-coloured reflections; the outer feathers of the tail capable of being raised higher than the others. A native of the West India islands.

Xanthronus. This is perhaps the most numerous section of the whole. Structurally, the birds of which it is composed differ from the former ones only in having the bill entirely straight. The manners of some of these are, however, much better known, if not more interesting. We shall give short notices of one or two of the best known species, some of which are migrants and great depredators.

X. Baltimore (Baltimore Oriole). Upper part blackish, with a tawny band across the wings; under part tawny; greater coverts black, with white tips; first quills dull white, edged with brighter; tail feathers orange above and white on the under side, the two middle ones black, and the bill lead-coloured. The female is different: the head, neck, and back variegated with olive green and brown; coverts and quills margined with white, the tail greenish grey. The young resemble the female, but are paler in the colours.

These birds are migrant within North America, ranging as far northward as Canada in the summer, but moving to the south in the winter, but not so far as the shores of the Mexican Gulf. They are very elaborate nest-builders. The nest is finely interwoven of vegetable fibres, and perhaps closer than that of the first sub-genus; but it is not nearly so long, nor hung in quite so pendulous a manner. It is in the shape of a pear, not completely roofed at the top, and with a hole in the side. Vegetable fibres form the principal part of the structure, but hair and wool are also made use of. The eggs are mottled with reddish spots. The birds have a very peculiar way of jerking their wings and tails, and showing their different colours as they flit from branch to branch of the trees.

X. icterus (large Banana bird). General colour deep tawny yellow, with the head, throat, wings, and tail black, and two white lines across the wings. Length between nine and ten inches. This is a very handsomely formed bird; and though the colours are not gaudy they are rich and beautiful. It is a very active bird and destroys a great number of insects. It is also said to kill and eat smaller birds, but this part of its history is not very well established, and it is contrary to the general habits of the family.

This species is found both in North and South America, and it is abundant in many of the West India islands, especially in Jamaica but in North America it keeps to the warm grounds, and also to the more southerly parts of the country. It is a gregarious bird, and exceedingly active; but during certain seasons it is very apt to commit depredations in the fields of bananas, on which account it is called the banana bird. The nest is constructed at the end of a branch, and is of a cylindrical form. The bird is very easily tamed, much attached, fond of being caressed, and not without its domestic use in those low and humid parts of the country where the houses are much infested with insects, as it captures these very expertly, and in great numbers.

X. phœniceus (the scarlet-feathered Indian bird). This species, which is equally conspicuous on account of its numbers and the colours of its plumage, is found in the whole range of North America, from Mexico to Canada, and probably, at certain seasons, to the shores of Hudson's Bay, where insects are exceedingly abundant during the summer months. The vast production of insect life in those northern parts of America, which renders the swamps and uncleared parts of the forest so very annoying to Europeans, is a very important part in the natural history of the insectivorous and omnivorous birds of that part of the world. The great difference in temperature, and consequently of productiveness, between the summer and the winter in Canada, and the regions to the north and west, between the sterile rocks of Labrador and the Stony Mountains, renders the summer season one of great activity for every species of life, both animal and vegetable. The summer temperature is as high as that of the West Indies, and as the day is longer in proportion to the night than in these islands, the growth is correspondingly vigorous. The winter, too, does not nip and wither the vegetation, as in many other cold countries, as the snow falls early, and forms a complete mantle to the ground, which remains till the warm weather again sets in; and as much of the ground is flat, and tangled with bushes, the water produced by the melting snow soaks into the soil, and affords nourishment to the plants during the whole summer.

The same circumstances are peculiarly favourable to the breeding of all those insects which deposit their eggs in the water—gnats, musquitoes, and all the other pests which are equally annoying in the damp forests of polar and of tropical countries, with only this difference, that they are perpetual pests in the latter, and summer ones only in the former. The width of the uninhabited parts of these countries, and their remarkable productiveness, occasion a migration of birds quite unknown in any other part of the world; and many of them, and the species now under consideration, migrate in such numbers, especially on their return southward, that, if the facts were not well ascertained, they would not be credited.

This bird is about the size of a common starling, of a black colour, but with a patch of bright crimson margined with yellow on each shoulder. The female is brownish, with pale margins to the feathers, and the red is not nearly so distinct. The male is subject to considerable changes of colour, being sometimes black and white, so that they have sometimes been multiplied into two or three species. In winter they resort in vast numbers to the plains in the lower valley of the Mississippi, where sometimes as many as three hundred of them are captured at one haul of the net; and formerly when the red patches of feathers were used as ornaments to female attire, there were instances in which one person caught at least 20,000 birds in the course of one winter. These birds breed in the marshes, and suspend their nests between reeds in the most accessible parts of them. The nest is, like that of all the family, curiously constructed, but the materials are, of course, those which the marsh affords, the leaves of reeds and of coarse grasses. They sometimes use mud in the structure, and always line the nest carefully with the most delicate vegetable fibres that they can procure. They prefer reeds as a means of suspension, but in the absence of these they will suspend it to a bush, though always in marshy places. They are very prolific birds, having usually two broods in the season, and four or five in each brood. The eggs are greyish white with black spots. In the marshes of the middle latitudes of their range, they feed much upon the seeds of the Canadian rice (*Zizania aquatica*); but in the cultivated parts of the country they are great plunderers, especially of the fields of maize or Indian corn; and from the depredations which they commit upon that grain, they are popularly called "maize thieves."

They attack the fields at two seasons of the year, that is, when the seeds begin to germinate, at which time they have a sweetish taste, and again when the crop is nearly ripe, in which state it is also soft and sweetish. They are exceedingly bold birds, so that when they attack a field in numbers it is very difficult to drive them off; and though their temerity makes them easily killed by the gun, they are not worth powder and shot on their own account; for though sometimes eaten, they are far from being palatable. Destructive as they are, however, it is highly probable that they do the farmers upon the whole more good than harm, from the incalculable numbers of insects and larvæ which they destroy; and which but for the birds would render many parts of North America unproductive and uninhabitable.

They are remarkably good-tempered birds, living readily in confinement, and even, if at all attended to, running about the house without any restraint, and following those who feed them, with expressions of fond recognition and regard. Their song is not one of the finest, though tolerable, but they make up in quantity, and their manners are exceedingly lively and playful.

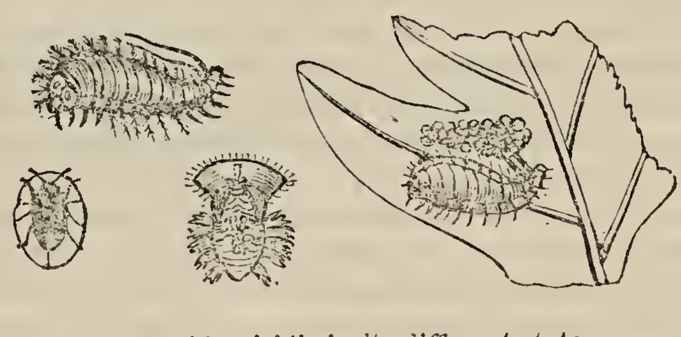
Oxyrhinchus. The distinguishing character of this sub-genus is, the bill quite straight, but much shorter than the head, whereas in the others it is as long or longer. There is but one known species, *Flamiceps*, which has a crest of long feathers mottled with red.

Dacnis. The birds of this sub-genus are very small; but in other respects they have the general characteristics of the family. The bill is conical and pointed. There are many species, but it will be sufficient to mention one as a specimen. They have sometimes been in part classed with the wagtails, and in greater part with the warblers but they do not belong to either. Their general colours are blue, black, and yellow. The best known species is, *De Cayana*, the Cayenne pit-pit, or Cayenne warbler. General colour blue, with the nape, scapulars, wings, and tail, black. Its colours, especially during the first two years, are, however, subject to much variation, and it has been multiplied into several species. The birds inhabit the forests, where they are gregarious, and perch in flocks on the tops of the highest trees. Most of the others are similar both in size and in habits; and it is not improbable that many of the described species are the same birds in different states of their plumage; and also that there are many others in the depths of the vast forests of Cayenne, Guiana, and similar parts of South America, which have not yet been discovered. To cross those forests is often no easy matter, to explore them properly is impossible, a thousand men occupied every day for a hundred years would still leave much to be found out in the highly interesting natural history of those most productive regions.

CASSIDA (Linnæus). The tortoise-beetles. A very extensive genus of coleopterous insects belonging to the section *Tetramera*, and sub-section *Cyclica*, and forming the type of the tribe *Cassidariæ* of Latreille, which is distinguished by having the antennæ inserted on the upper surface of the head, nearly together, straight, short, filiform, and cylindric, or somewhat thickened toward the tip; the mouth is placed entirely on the underside of the head, the various parts being very short, but the mandibles are broad and strong; the legs are short with the tarsi flattened, the third joint being deeply cleft, receiving between its lobes the terminal joint. The body being flat beneath, enables the insects, with the assistance of these flattened tarsi, to lay close to the leaves upon which they are found, and where they often remain immoveable; the form of the body is generally orbicular or oval, the head being often completely concealed beneath the thorax, the margins of which, as well as of the elytra, are greatly dilated, so as to give the insects the appearance of small tortoises, especially, as on being disturbed, they contract their antennæ and legs under the broad sides of the thorax and elytra, so as completely to conceal them. These insects are of very varied colours, which, especially in the larger exotic species, are elegantly disposed in spots, lines, bands, &c., upon grounds of different colours. They are entirely herbivorous in their habits. The genera are *Alurnus*, *Hispa*, *Chalepus*, *Imatidium*, and *Cassida*. In the first of these are contained the largest species of the tribe, being chiefly inhabitants of South America; they are of an oval form with the head uncovered.

The genus cassida is distinguished by its orbicular or nearly ovoid form, with thorax generally semicircular, covering and concealing the head and furnished, as well as the elytra, with a broad dilated margin extending far beyond the sides of the body, as may be seen in our figure of *Cassida viridis*, the under side of which is represented. The mandibles are short and strong with several teeth. Scarcely any of the species exceed one inch in length; but amongst the exotic species many very remarkable forms are to be observed: several Brazilian species are armed with two erect spines on the centre of the elytra, which meet together when these organs are closed, forming an acute and robust horn nearly half an inch long. Some of the species are highly metallic, amongst which are several British species; the latter, however, lose their beautiful colours when dead, but which may be reproduced by dipping them into hot water.

It is not, however, in the perfect state alone that nature has furnished these insects with a shield-like covering for their defence, since, in the earlier period of their existence, they are provided with the means of constructing a covering of the most singular nature. Reaumur has given us very ample details of their proceedings, and it is from his figures, corrected from our own specimens, that our illustrations of this genus have been derived.



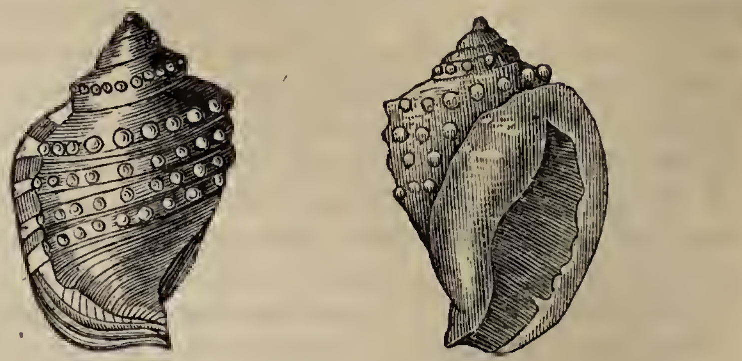
Cassida viridis in its different states.

The larva of the tortoise-beetles is rather broad, rather narrowed behind, and of a flattened form, with the sides of the body furnished with branched spines or setæ. The extremity of their bodies is also furnished with two long and slender scaly appendages terminating in a point, and which form a kind of fork, which is generally recurved upon the back of the larva; the anal aperture is placed at the base of this fork upon a fleshy tubercle, which the insect has the power to raise or depress at will; and the insect has the extraordinary instinct by the assistance of this apparatus to collect its excrement, which is pushed forward and upwards, sliding along the fork, when it has accumulated at its base, by means of the contractile motion of the abdominal rings; thus a roof is by degrees formed, the particles of which are glued together, so that at length a covering, or umbrella, sufficiently large to conceal the entire body of the tender larva is produced, it is of course subject to the motions of the fork by which it is supported, so that it is sometimes even carried perpendicularly. As, however, this parasol would in time become unwieldy, we find this inconvenience provided against by the casting of the entire skin, not only of the body, but also that of the various spines, as well as of the supporting fork. This takes place several times previous to the larvæ being transformed into pupæ. It is a difficult operation, and at the period of the last moulting, i. e. on becoming pupæ, the tails are completely lost. It is upon the same leaf that the larvæ has to undergo these moultings as well as to assume its quiescent form. To prepare itself for this, it ceases to hold the tail either in a raised or recumbent position upon the back, but, on the contrary, stretches it out behind in the same line as the body. It attaches itself to the leaf by the two segments which follow the last pair of legs; the skin then breaks behind the head, and by degrees is sloughed entirely off, having previously remained tranquil for two or three days. The exuviæ, however, remain for some time at the extremity of the body, which has caused incautious observers to state that the pupa is furnished with two prongs as well as the larva. The pupa is flat, nearly oval, with the head concealed beneath the thorax, which is very large, and of a semi-lunar shape in front, being bordered with spines. This portion of the body has been incorrectly figured by Reaumur as divided by a slit down the middle, it is, however entire: the abdominal portion is also bordered by large leaf-like appendages of a flat shape, and pointed at the sides and tip. The pupa is green, and in the underside of the body are clearly to be observed the antennæ, legs, and other parts of the perfect insect, which makes its appearance at the end of fifteen or twenty days after the larva sheds its last skin.

The females lay their eggs upon the leaves of various plants, as thistles, burdock, &c., arranging them side by side, and forming them into patches often covered with excrement.

The genus cassida is the only indigenous group belonging to this tribe, there being nearly twenty species, most of which are, however, rare. The *Cassida equestria* of Fabricius is one of the largest and most common example.

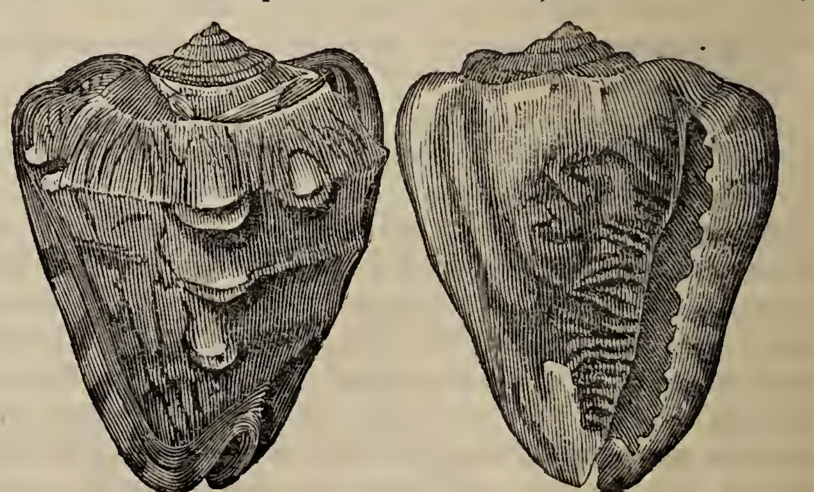
CASSIDARIA (Lamarck). This genus of molluscs must certainly be considered very nearly allied to the genus *Cassis;* a separation is however necessary, from some manifest differences of character. The shell is generally more inflated and rounder than those of the *Cassis,* and a very marked distinction is observable in the canal which terminates the lower part of the aperture. This, in the *Cassidaria,* is ascendent, and very little arched (while in the *Cassis* that part is *abruptly recurved* towards the back of the shell); the spire is short, conoid, composed of convex whorls, without any thickened bands; the left margin apparent and affixed to the columella, which is most generally covered with small rough, oblong, transverse tubercles; right lip plaited or thickened; exterior tranversely grooved, and the upper part of the whorls, in some species, regularly dotted with round tubercles. They have a horny operculum, and are found in the seas of warm latitudes; seven or eight species are known; that figured here is the *C. echinophora,* and strongly defines the peculiarities



Cassidaria echinóphora.

of the genus. They are thus subdivided:—1st, The oval sub-globular species, with the canal sub-ascendant; and 2nd, The oblong sub-cylindrical species, with a very short straight canal, forming Sowerby's genus *Oniscia.* De Blainville places this mollusc in his second class *Paracephalophora;* first order, *Siphonobranchiata;* second family *Entomostomata.* The animal, according to Adanson, is the same as that of the *Purpura* and its congeners. Several fossil species are known.

CASSIS (Lamarck). A genus of molluscs necessarily separated from the Linnæan genus *Buccinum,* in which the notch at the base is but slightly defined, compared with the canal at the base of shells of this genus, which is lengthened and abruptly turned towards the back; the form of the aperture is also very distinct, being longitudinal, straight, and nearly always dentated on the right side, the flattened side of the columella lip forming a very considerable angle, the spire seldom much elevated, frequently interrupted by thickened bands, or varies obliquely, having formed so many terminations or lips of the previous stages of growth, and constituting the discriminating character of the first section of the genus; the second not possessing these bands, the general form of these shells is inflated, the columella plaited or wrinkled transversely, the exterior smooth or nodulous, and the spire with bands or nodules only. They sometimes attain a great size; and in one species the columella lip projects above the spire, giving a flat ovate-angular appearance to the lower surface of the shell. They have a horny operculum, and are marine shells, inhabiting principally the Indian seas: nearly thirty species are known; two or three of which are however found in the Mediterranean. Several fossil species are described; that figured here is the *C. tuberosa,* internal portions of which, as well as of the



Cassis tuberosa.

other species, are exquisitely sculptured by Italian artists in imitation of antique cameo gems, the different strata of colouring matter resembling those of the onyx and other precious stones. Of these, a great variety of ornaments are made; of late years a considerable trade has been carried on in them particularly on the continent. The name of this mollusc is derived from a helmet or casque. This genus is of the same class, &c., as CASSIDARIA; which see.

CASSOWARY—*Casuarius*. A genus of birds belonging to the *Struthionidæ*, or Ostrich family, or to Cuvier's order of stilt birds, division *brevipennes*, or short wings.

The characters of the genus are: the bill straight, short, compressed at the base, rounded near the point, furnished with a ridge on the culmen, and the basal part extending backwards on the head, on the summit of which it forms a large, rounded, and elevated horny crest; the lower mandible of the bill soft, flexible, and angular near the tip; the nostrils pierced laterally in the bill, near its point, rounded, and opening in the front; the legs strong and muscular, with three toes all directed forward, the inner ones short, and armed with a very long and strong claw; the tarsi almost entirely feathered; the wings not at all adapted for flight, or even for balancing the bird when it runs swiftly, as is the case with the wings of the ostrich. This genus also differs from the ostrich in its internal anatomy, so as to indicate a different quality of food. It is still a gizzard bird, and therefore, in part, a vegetable feeder, but the walls of the gizzard are not nearly so strong and muscular as those of the ostrich, and the intermediate stomach between the craw and the gizzard is altogether wanting. The intestinal canal is also considerably shorter, and the cæca are very small.

There is only a single species, *C. galeatus*, the helmeted or crested Cassowary. It is the largest of birds with the exception of the ostrich. The general colour is black, but apt to fade into a dark sooty brown. The head and upper part of the neck are bare of feathers, of a blue colour, with flame-coloured reflections in the breeding season, or when the bird is in high condition. The helmet, or horny protuberance on the head, extends from the base of the bill to the middle of the crown; it is about three inches high, black on the fore part and yellow behind; on the sides of the neck, immediately under the ears, there are wattles, one on each side, something resembling those of the turkey-cock, and changing the colours in a similar manner, and from similar causes. The prevailing colour is purplish red, which deepens when the bird is excited, and becomes pale when it is exhausted. There is also a bare spot on the breast, covered with a callous or indurated skin, and the bird rests its weight upon this when it squats upon the ground. The rest of the body is pretty uniformly covered with blackish brown feathers, the webs of which are loose and flocculent, and have more the appearance of long loose wool than of feathers; but none of them are produced like the ornamental feathers of the ostrich. Some of them are, however, of considerable length; those on the rump are not less than fourteen inches, and they are pendulous, and form a sort of substitute for a tail. The wings, which indeed hardly deserve the name, are not feathered; but, in place of quills, they have five naked shafts in each, bearing some resemblance to the quills of the porcupine; and it is said that the male birds use those spinous shafts in their combats with each other, and also for a defence against enemies.

The body of this bird is as large as that of the ostrich; its neck is considerably shorter, and its bearing is not so majestic, so that it does not look nearly so formidable. The eggs are of smaller diameter, and rather longer than those of the ostrich.

Their ground colour is a delicate greenish grey, very beautifully marked with spots of grass-green, which are raised as if they were bits of enamel fixed on the shell. Towards the smaller end they have some white markings. These eggs are deposited in the sand without any formal nest, and the heat of that substance is often sufficient to hatch them without any assistance from the parent bird; but it is not true that these birds desert their eggs any more than the same is true of the ostrich, though it has pretty generally formed part of the description of both birds. When the temperature or state of the weather renders it necessary, these birds sit on their eggs as carefully as any other members of the class; and when the circumstances come round which enable them to dispense with sitting, they bring along with them a necessity on the part of the bird to spend the greater portion of its time in searching for its own food.

Here we cannot help remarking, that a very beautiful provision of nature for the preservation of those wingless birds of the wilderness has been most unphilosophically turned into a ground of accusation against the birds; and among romancers, the ostrich has, time out of mind, been used as the emblem for those unnatural parents of the human race who desert their offspring in its helpless years. Now, if it is borne in mind, that in those countries which birds of this family inhabit, there are many months without a shower, and with the hot sun beating on the naked surface all day long, at such times the food of the bird is of course scanty, and so scattered, that to procure one bill-full a journey must be undertaken; under such circumstances, one bird could not feed another, as the males of many of our birds feed the females, when they do not take turn with them in sitting. Hence it is necessary that, in this hot and dry weather, the female bird should have free range during the day, in order to maintain her own life; but when there is rain, food is much more abundant, and then the females of those birds do sit on their eggs. Even in the hot weather, when dews fall heavily, and they are frequently both heavy and chilly, the birds also sit; and when not sitting, they watch their eggs with most maternal solicitude. Thus, instead of the apparent abandonment of the eggs in dry weather being any evidence on the part of the birds, it is a proof of how very, beautifully the instincts of the bird are adapted to the circumstances of its native place. For the bird to sit, during the heat of the sun, upon the hot sand, would be injurious, and it would be perfectly useless, as the heat of the sun and sand alone is quite sufficient for the purpose; and were the bird to sit then, it would hinder rather than promote the hatching of the eggs; but whenever circumstances render it necessary, the bird is as true to her instinct as any other of the children of nature; and though she is in the desert, she is as completely preserved and protected there as the animal which dwells in the fullest pasture.

The cassowary is found only in the south-eastern parts of Asia, and nowhere without the tropics. The Molucca islands, and Banda, Java, Sumatra, and especially the forests of the southern part of the island of Ceram, are their principal localities; but they are rare birds everywhere. Their food is chiefly vegetable matter, but the succulent kinds, and not those which are hard and dry. They are fierce and powerful birds, striking severely with their bills, and kicking with great power with their feet. They are easily tamed, and will bear the climate of this country without injury; but they are objects of curiosity, and not of use, as their flesh is black, tough, dry, and tasteless.

CASSUVIEÆ, or ANACARDIACEÆ (the Cashew Family). A natural order of dicotyledonous plants, containing thirteen genera and nearly one hundred and twenty species, described by Jussieu Decandolle, and some other botanists. This order, as well as *Spondiaceæ*, *Burseraceæ*, *Amysideæ*, and *Connaraceæ*, are considered as divisions of *Terebinthaceæ*. All these orders bear strong affinities to each other, but still they have essential characters sufficiently well marked to induce Brown and Künth to separate them into distinct families.

The Cashew tribe is thus characterised: flowers generally unisexual; calyx small and persistent, with five or seven divisions; petals equal in number to the segments of the calyx, perigynous; stamens usually equal in number to the petals, and alternate with them; petals and stamens inserted upon the calyx or calycine disk; ovary single, one-celled, with one ovule; styles one to three; fruit indehiscent, most commonly drupaceous; seed without albumen; cotyledons thick, folded upon the radicle.

The plants of this order are trees or shrubs, with alternate, simple, or ternate leaves, and terminal or axillary flowers, provided with bracteas. They grow chiefly in the tropical regions of India, Africa, and America. Some species inhabit the south of Europe, and other countries without the limits of the tropics, such as the northern parts of America. They are propagated by cuttings, layers, and seeds.

The *Cassuvieæ* abound in an oily resinous juice, which occasionally possesses acrid and poisonous qualities, and which is applied to a variety of uses in the arts.

The order has been divided into two sections: first, *Anacardieæ*, including the genera *Anacardium*. *Holigarna*, *Mangifera*, *Buchanania*, *Pistachia*, *Comocladia*, &c., in which the cotyledons are thick and folded back upon the radicle; and second, *Sumachineæ*, including the genera *Rhus*, *Schinus*, and *Duvana*, in which the cotyledons are leafy, and the radicles bent back upon their line of union.

The genus *Anacardium* may be considered as the representative of the order *Anacardium occidentale*, which furnishes the well-known Cashew or Acajou nut. There are two varieties of the plant, one found in the West, and another in the East Indies. It is an elegant tree, bearing panicled corymbs of sweet-smelling rose-coloured flowers, and an edible fruit of a yellow or red colour. The fruit or apple has a somewhat acid flavour, and a considerable degree of astringency, and its juice, when fermented, yields an agreeable vinous liquor. The nut grows in a singular manner, supported on the enlarged fleshy and pyriform peduncle. The kernels form a delicious article of food, and are used in the West Indies as a dessert.

Cashew nut.

When ground with cacao, they form excellent chocolate; and when roasted, they are mixed with Madeira to improve its flavour. From the nuts an oily fluid is procured, which turns black and thick by exposure to the air, and is used in India to make varnishes. The fumes which arise from the nuts, during the process of roasting, are very acrid, and are apt to produce inflammation. An aromatic substance is procured from the tree, which was formerly used in medicine. For a drawing of the tree, and a full account of its properties, see article on ANACARDIUM.

Semicarpus Anacardium, or *Cassuvium*, yields a nut, the juice of which is used for marking table-linen and articles of dress; hence the tree has received the name of the *marking-nut tree*. If linen is placed on the nuts, and pricked through, an indelible stain is produced in consequence of the exudation of the juice from the nuts. The nuts of this plant, and the berries of *Holigarna longifolia*, another plant of this family, after being steeped for a long time in water, furnish by expression a juice which, by a particular mode of preparation, forms the varnish of Sylhet, in Bengal. The wood of the plant is soft, and contains acid juice. The fleshy receptacles, when roasted, are edible, and have the flavour of apples. The green fruit, pounded into a pulp, makes good birdlime. When ripe, the juice is used by the Telinga physicians in various disorders.

The varnishes which are yielded by several plants of this order, such as the *Cashew*, *Semicarpus*, *Melanorrhœa*, *Usitatissima*, *Stagmaria verniciflora*, and several species of *Rhus*, to be presently noticed, are very deleterious in their effects on the human body. They are highly acrid, and, when applied externally, produce inflammation and swelling to such a degree as sometimes to endanger life.

Several species of *Schinus* are filled with a resinous juice, which is easily expelled, in some cases by simple emersion in water. The oily fluid is said to be thrown out in such a way from the leaves of some of these plants, when thrown on water, as to make them move in a circle. *Schinus acroeria*, probably from the spontaneous exudation of an acrid fluid, is said to excite inflammation and swelling in those who sit or sleep under its shade. A similar remark is made in regard to *Stagmaria verniciflora*. The fresh bark of *Schinus molle*, Peruvian mastic tree, is employed to give a coating to ropes, which prevents their ready decay. A substance like mastic exudes from the tree, which is used in Peru as a dentifrice. The berries have a beautiful rose-colour, and the acid juice which they yield is used as vinegar in India. The inhabitants of Peru prepare a vinous liquor from them.

Stagmaria verniciflora, a native of the East India islands and Sumatra, furnishes an acrid resin which causes excoriations and blisters, and which is an ingredient in a varnish similar to Japan lacquer.

Rhus, or *Sumach*, is another genus of the order, containing many important species, several of which yield a milky juice possessing poisonous qualities. *Rhus coriacea*, elm-leaved *sumach*, from its astringency, is used in place of oak-bark in tanning. Leather in Turkey is chiefly tanned with this plant. The seeds are used at Aleppo to increase the appetite, and both the leaves and seeds are employed medicinally as astringents and styptics. The ancients used this plant, instead of salt, for seasoning meat. The plant grows abundantly in Spain. The bark of *Rhus glabra* is used as a mordant for red colours, and acts as a febrifuge. The leaves of the plant dye red, and the branches, boiled with the berries, give a black ink-like fluid. *Rhus vernix*, or *venenata*, affords the true Japan varnish. This substance oozes out from incisions made in the tree, and becomes black and thick by exposure to the air. With it the Japanese varnish the posts of their doors, their windows, and all their articles of furniture. The whole plant is acrid and poisonous. When applied to the skin, it produces inflammation, and a copious pustular eruption. *Rhus pumila*, and *radicans*, also possess poisonous qualities. *Rhus toxicodendron*, poison-oak, is another species of this genus, found native in North America. The juice of the plant is white, but turns black by exposure, and is used as a varnish. A volatile matter arises from the living plant, which inflames and blisters the skin. This noxious exhalation is said to take place chiefly during the night. The plant possesses both acrid and narcotic qualities. The leaves, in small doses of a quarter or half a grain, act as a powerful stimulant, and appear to exert a particular influence on the skin. They have been employed successfully in some obstinate cutaneous eruptions, in chronic rheumatism, and in palsy. They are said to excite a feeling of heat and pricking in paralysed limbs, which have sometimes been succeeded by the happiest results. It is a dangerous medicine, and always requires to be administered with the greatest caution. *Rhus cotinus*, Venice sumach, or wild olive, is cultivated for the purpose of tanning leather near Balcimara, in the Apennines. The wood is used by the modern Athenians for dyeing wool of a rich yellow colour. Several species of *rhus* are cultivated in gardens. The expressed oil of some of them acquires the consistence of suet, and serves for making candles.

Pistacia is another genus of the order which deserves to be noticed. *Pistacia vera*, or *officinarum*, Pistachia tree, is a native of Syria, and the countries near the Mediterranean, and is extensively cultivated in Sicily on account of its nuts, which are an article of commerce. The nut is fully the size of a filbert, and encloses a kernel of a pale greenish colour, having a sweetish unctuous taste, and yielding a quantity of oil.

Pistacia lentiscus, and *Atlantica*, both of which are natives of the south of Europe and the northern parts of Africa, furnish the resin called mastic. The former of these plants is a tree ten or twelve feet high, which flowers in May, and ripens its fruit in August. It does not thrive well in Britain, although it appears to have been cultivated in this country so early as the year 1664. Mastic is got from these trees by incisions in the bark, which are generally made in the month of August. A yellow resinous juice exudes, which gradually concretes. The Turkish and American women chew it, in order to make their breath agreeable, as well as for the purpose of whitening their teeth and strengthening their gums. It is also used to fill cavities in carious teeth. The tree is burned in order to furnish an agreeable fumigation. Mastic, as a medicine, is tonic and astringent, and is given in cases of debility, spitting of blood, and diarrhœa. The wood of the tree receives the name of *lignum lentischinum*, and was formerly supposed to possess medicinal virtues. It is now chiefly used in Portugal to form tooth-picks. *Pistacia terebinthus*, a native of Barbary and the south of Europe, and which has been cultivated for more than sixty years in Britain, yields the Chian, or Cyprus turpentine. It is the most esteemed of all the turpentines on account of its pleasant odour and its taste, which is neither bitter nor acrid. The turpentine is got by wounding the bark in the month of July. The resinous juice which exudes becomes thick by exposure to the air, and is easily collected. The quantity got is very inconsiderable, from large trees sixty years old, only yielding two pounds nine ounces and six drachms. In consequence of this, the price of the article is high, and it is very apt to be adulterated. The best Chian turpentine is like honey, having a clear transparent whitish colour, and a fragrant smell. Its taste is warm, not at all acrid.

Mangifera Indica, the famous Mango tree, is a large spreading tree, with leaves seven or eight inches long, and two or more broad, sending forth loose bunches of flowers, which grow at the end of the branches. The wood is brittle, and of a brown colour. It is used in India for burning bodies and for making coffins. The fruit is a kidney-shaped berried drupe, the size of a large plum, and of an orange tawny colour, with a tinge of red. The flesh round the nut is soft, pulpy, and luscious. The fruit is juicy and wholesome, and is much esteemed in

India. It is very high flavoured, and so fragrant as to perfume the air a considerable way around it. The plant has been cultivated in Britain with the view of producing fruit, but the attempt has scarcely as yet been crowned with success. The unripe fruit is pickled in the milk of the cocoa nut, after it has become sour, along with salt, capsicum, and garlic, and in this state it is brought to Europe. It is also eaten preserved in sugar. From the juice of the fruit a kind of wine is prepared, and the kernels, when reduced to powder, form an excellent flour, used in the preparation of bread. There are as many varieties of Mango as there are of apples and pears.

Comocladia integrifolia is a handsome tree, which produces a deep red edible fruit. *Comocladia dentata* is said to be injurious to those who sleep under its shade.

The Chilian genus, *Duvana*, resembles the myrtle tribe.

CASTALIA (Lamarck). A genus of molluscs, thus described by Lamarck. The shell equivalve, inequilateral, sub-triangular; apices eroded, and curved towards the posterior side; hinge with two lamellar teeth, transversely striated, one of them posterior, distant, shortened, and sub-trilamellar, the other anterior, lengthened and lateral; ligament exterior; the substance of the shell is thick and pearly; the valves with longitudinal flat ribs, transversely striated, but not extending to the upper margin, and covered with a brown epidermis. It is said to resemble the genus *Trigonia*, but the number and position of the teeth are more like those of the *Unid*, of which genus De Blainville has made it a species, and consequently places it in the third class, *Acephalophora;* third order, *Lamellibranchiata;* sixth family, *Submytilaceæ.* It is a fresh-water bivalve, and the animal probably resembles that of the genus *Anodon.*

CASTNIA (Fabricius). A remarkable genus of South American lepidopterous insects, the situation of which appears to be very doubtful, the insects partaking of the characters both of the moths and butterflies; the wings are broad, the antennæ are thickened towards the tips, terminating in a style, the palpi are short, thick, and cylindric. The species are, for the most part, of beautiful colours, and of a large size. Madame Merian has given figures of the transformations of one of the species; but lepidopterists have considered these representations as inaccurate.

CAT—*Felis* or *Felinæ*, THE CAT TRIBE. A very numerous genus of carnivorous animals—the most numerous, indeed, as well as the most powerful, and the most exclusively carnivorous, of all the mammalia. They are also the most generally distributed over the globe, being found, in one or other of the species in every latitude, and in all parts of the world, with the exception of Australia and the Polynesian islands, in which none have hitherto been discovered. They are the animals to which especially the name of "wild beasts" or "beasts of prey" is applied; and each of those names is far more descriptive than many of the popular names given to other races of animals. They are, strictly speaking, wild beasts; inasmuch as the generality of them belong to wild nature only, and disappear before the progress of population and culture. One species, the domestic cat is, indeed, a remarkable exception to this; for it is found in a domestic state only, in endless varieties of colour; and neither the original place of its habitation, nor the original race in a state of nature is at all known. It is indeed sometimes said that the wild cat, which is found in brakes and unfrequented places of Britain, and generally in similar places throughout Europe, is the parent stock of the domesticated species; but there appears to be little truth in this statement; as it is ascertained that in very remote times, when the country was not so well inhabited as it is now, and when in consequence wild cats were so abundant as to be troublesome, tame ones brought a far higher price than they do now. Indeed, at present, they have no marketable value except an ideal one from favouritism, which is of itself a strong proof that they have belonged to civilisation, and to civilisation only, not only from its first establishment, but that they have accompanied its march, like the ox and other domestic animals, from the time of its commencement. The real use of the domesticated cat has always been as a mouser; and it is natural to suppose that mankind no sooner began to accumulate stocks of provisions to serve them during those times when the earth is unproductive, than the small animals accumulated in their dwellings; and as most of the original houses, in temperate parts of the world, were in part at least constructed with mud, they afforded more easy lodgment for these little animals, than modern houses, which are constructed of brick or stone, and thus the service of cats became of more value.

Besides the common domesticated cat, there are some of the more mild-dispositioned of the others which are trained, in some parts of the world, for hunting; not that they follow the game by the scent, or even by speed through a long chase, like the dog family; for they must be carried till they are within sight of the game, and at no great distance from it; and they make their capture by springing upon it at one bound. The more powerful ones are known only in the wild state, or as kept in dens at menageries for the purposes of exhibition. But it must not thence be inferred that they are untameable, any more than even the mildest animals with which we are acquainted; for though none have been absolutely tamed in modern times, and though we may doubt the accounts of the generous forbearance of lions recorded by ancient writers, yet there is no question, that, if it were worth the trouble, the most naturally ferocious of them could be domesticated. The only question as to the taming of any animal is, whether its use when tamed would justify the trouble and expense; and the powerful animals of this genus use their strength so much by fits and starts, and are so indolent, except when excited by hunger, that it is not very easy to see to what use they could be applied.

If, however, a use for them could be found out, there cannot be the least doubt that, though they might perhaps require a little more careful management, in proportion as they are irritable in a state of nature, all animals whatever might be reduced into a state of perfect obedience to man; the purchase of that obedience being the constant and timely supply of their natural wants, and by this means the prevention of those excitements which are absolutely necessary for their preservation, so long as they have to depend upon themselves for subsistence.

It is in the study of those more powerful, and as we are accustomed to say, more savage animals, which live upon the flesh of other warm-blooded animals, that we have the best means of correcting those erroneous notions of the animal kingdom, which we are so apt to derive from judging of its members as we judge of mankind. Men proceed, both in passion and in action, by the judgment of experience, that experience never amounts to an absolute certainty, and in very many, perhaps the greater number of instances, it is weak and erroneous. Hence, human beings are often excited to foolish or unnecessary passion, and stimulated to erroneous, useless, or improper action. Men are therefore often cruel, deceitful, injudicious, and the whole list of the results of mistaken judgment, that can arise either from ignorance, improper habits, or uncontrolled passions. But in these respects man stands singly in the world, the only being in it capable of moral good and moral evil,—the only being that can decide by his own judgment; and therefore the only being which can in any instance be said to do wrong. But we are apt to overlook this distinction, and impute something resembling virtue and vice to animals, in the same way that we are disposed to attribute to them a certain inferior degree or species of reason.

This is a much more serious error than those who do not reflect carefully upon it are apt to suppose; and the mischief of it operates in two ways;—it leads us to treat beasts as though they were men, and also to treat men as though they were beasts; and although we do not take the trouble of tracing this root of evil in every or almost in any case, yet there is not the smallest doubt that to it are owing many of those crimes, follies, and sufferings, which so chequer the annals of the human race.

Among animals, as among plants, there is nothing which can, in any rational sense of the word, be considered as evil. The creature, whatever may be the nature of its food, and however it may destroy other creatures in the obtaining of that food, has no bad passion to gratify, no purpose of any kind to serve—that is, no purpose planned by itself; for, how artful soever it may appear to us to be in the capture of its prey, or even in the construction of snares to assist in that capture, stlll we can refer its operations to nothing save general obedience to the grand law of nature, of which its actions form a part, so long as that action is necessary for maintaining the proper balance of the system—that is, the greatest good of the whole; and when this necessity for it ceases, when circumstances, sometimes open to our observation and sometimes concealed, come round and render it less necessary, its members fall off; and when the necessity for it ceases altogether, its bones are only found in the earth as memorials of a former and different state of things, and they no doubt remain there, in part at least, to stimulate us to inquiry into a longer acquaintance with the earth's history than we can obtain from those events which we see taking place around us. The most powerful animals of the genus under consideration are met with only in those parts of the world where the powers of life are remarkably active, subject to much seasonal change, and liable to be overrun by wild plants of lofty growth, and wild animals of various kinds, if man, in consequence of war, or any of those other vicissitudes by which places become depopulated, suspend his cultivation even for a few years, and therefore the fossil bones are not so numerous as those of some other places; but still there are bones of those animals, of much larger species than any now met with alive to be found in caves, and other accumulations of animal remains, both in the middle latitude of the continent and Great Britain. But still it is as living animals that this genus belongs to popular natural history.

It is worthy of remark, that as birds of prey form the best defined natural group of the feathered tribes, so the genus *felis*, which to them, in as far as there can be a correspondence between birds and mammalia, in being the best defined natural group in the whole class. There is this further in common that, though many of the species are readily enough distinguished from each other, yet there are many in which no specific distinction can be clearly established, just in the same manner, and nearly to the same extent, as this difficulty occurs in the birds of prey. There is never the smallest difficulty in deciding whether an animal does or does not belong to the cat family; but there are many instances in which it is not easy to refer to the proper branch of the family to which the individual belongs. This confusion of species seems to be inseparably connected with that well-defined general character which marks the genus or the group; and though at first sight this may appear to be a difficulty in the study of those animals, it is a difficulty only to the systematist; for to the popular naturalist, who seeks a knowledge of the animals themselves, and not of the mere arrangement of them, it a great advantage to be able to include a number in one general description; and with the exception of size and colour, this can be readily done in the genus *felis*.

The generic characters are: six incisive teeth in each jaw; two strong canines in each, conical, slightly bent, very sharp pointed, those in the upper jaw the largest, and locking behind and partly outside those in the under. Three cheek teeth in the upper jaw arranged in a row, with trenchant carnivorous edges; three similar ones in each side of the lower jaw; and in the upper jaw, within side the cheek teeth, a tooth standing cross-wise with a flat or blunt top against which the point of the carnivorous tooth of the lower jaw acts much in the same manner as a butcher's cleaver acts in dividing flesh on his block. The tongue is beset with bony prickles, reflected backwards in the form of hooks, so that in drawing backwards across a substance, and pressing it at the same time, it abrades like a file.

Such are the general characters of the mouth in all the animals of this genus, and here we have another remarkable coincidence between them and the birds of prey. This mouth is not a proper instrument of prehension, as neither is the beak of rapacious birds. Each group is furnished with other instruments of prehension; and though the cats generally seize with the mouth at the same time that they seize with the claws or strike down by the blow of the paws; yet their mouth is a tearing instrument; and they do not snap with it, even at the smallest prey, as is the case with most carnivorous animals which have not prehensile claws. The mouth is, however, very powerful as an instrument of adhesion; and the structure both of the teeth and tongue is calculated to produce very destructive and painful laceration in every animal upon which they can fasten, if the skin is not tough and hard enough to resist their bite. This latter is the case with some of the *Pachydermata*, such as the elephant, the rhinoceros, and the hippotamus, especially the two latter, and even with some of the buffalo tribe, which are consequently not attacked by any but the largest and most powerful of the *felinæ*, and only by them in cases of extremity.

The shape of the head accords with this general action of the mouth. The head is round, generally flattened; the jaws short; the ears placed high on the head, and a large space left on the cheek for the insertion of those large and powerful muscles which move the lower jaw. This form of head is not calculated for giving so effective a snapping bite as can be given by those animals in which the jaws are long, because the long jaw acquires a momentum, and cuts by impulsive action, while the short jaws of this genus cut more by pressure, like a knife. Thus the same muscular action does not produce the same sharpness of bite; but it holds on much better, and this, together with the tearing action is that which accords best with the other structures, and with the habits of the animal. We have an instance of this difference of the action of long jaws and short ones in the hound and bull dog. The deep mouthed hound gives a powerful bite, but cannot retain his hold; the bull dog on the other hand does not bite so sharply in proportion to his strength, but he is much more staunch in keeping his hold.

The paws and their armature are remarkably well adapted for the offices which they perform. There are five toes on each of the fore-feet, and four on the hind, all of which are armed with very sharp crooked claws, which have their inner or convex edges with two trenchants or cutting ridges, like those of the more formidable birds of prey. The fore paws are the really efficient instruments in the capture of the prey; and for this purpose they are furnished with very strong bones,—bones which in the largest and more powerful species, are heavier in proportion, and also stiffer and less liable to be broken, than the bones of any other animals. By this means the paw becomes a very formidable striking instrument; and the stroke of it fells a small animal to the ground as if it were struck by a sledge hammer. It is, however, in the clutch of the paw, and not in the stroke of it, that the chief use of this formidable weapon exists. When the animal is in a state of repose, or when it is prowling about in search of its prey the claws are not visible; they are drawn back into sheaths on the insides of the toes, so that their points or their trenchant edges are never blunted by contact with the ground. This retraction of the claws is not produced by any muscular effect on the part of the animal, but it is the result of the mere elasticity of a ligament which is attached to the last phalanx of the toe—that which carries the claw. This phalanx is very short, its length being considerably less than its height; and when the flexor muscles are not in action, the ligament turns its back more than a third of its circumference. Except the retraction and repose which it receives from the elasticity of this ligament, the claw, the phalanx to which it is attached, and the muscles by which it is moved, when occasion requires, do not come into play in the common walking motions of the animal. The paw is thus, if the expression may be admitted, a double instrument, or perhaps even a triple one: it is a walking foot, it is a clutching foot, and it is a striking foot; for when the animal merely hits a blow, the claws are not protruded. The flexor muscles are, however, very powerful ones when they do come into action; and as they are never fatigued by the common motions of the animal, they are always fresh and ready for the attack.

Besides the advantage to the action of the claws themselves, which results from this structure, there is another advantage in the general economy of the animals. They are all prowlers, and liers in wait, seizing their prey by stratagem; and as the soft part only of their feet comes in contact with the ground, they move much more silently than any other animals; and as they keep their eye fixed upon the prey while they are endeavouring to approach so near it as that it may be secured, they walk with great circumspection; and, as all their joints, though fit for very energetic momentary action, are supple and elastic, they plant their feet as if they were let down upon both springs and cushions contrived with the greatest delicacy. There is, indeed, no part of their history more curious than the contrast which the extreme softness of their foot-fall upon ordinary occasions makes to the firmness and force with which they strike, when the flexors of the last phalanges are brought into action, and the claws all projected in order to take effect. This part of their action, never takes place, however, till they work themselves to the utmost degree of excitement, which, in the powerful ones is attended, and in all probability heightened, by a very harsh, and by no means a pleasant roar. It has been said that the object of this roar is to confound and stupify the prey, so that it shall not be able to escape; but the spring follows so instantaneously, that the prey is under both the claws and the teeth before this note of terror is heard; and if the animal is difficult to be overcome, the preyer often finds it necessary to excite his energy by fresh roars, and these are always attended with a new wrench with the head, a new clutch with the claws, and a violent convulsive action of the whole body.

In the more formidable species, which prey upon large animals, and prey comparatively seldom, those exhibitions are grand, though they are not either very pleasant or very safe for near observers, and therefore not very often seen. Those of the less powerful ones, which prey upon birds and small quadrupeds, are more of every day matters, and they take place oftener, and generally speaking, they take place comparatively in silence; and when they growl over their prey, it seems rather to be from fear of losing it than from any other cause.

As compared with the power which these animals evince in their proper manner of preying, they are feeble animals on their march. That looseness or flexibility of all the joints which enables them to steal so softly through the brakes and bushes, and come so unexpectedly upon their prey, and which also enables them to concentrate the action of their whole bodies into the spring which they take, and into those bounding leaps by which they endeavour to escape from danger, is not well calculated for steady walking, or long continued running. The more powerful the animals are, the joints of the legs, and especially those of the spine, are the more free in their articulations; and hence, when a lion, a tiger, or any of the more formidable species, is seen moving about in his prison house at the menagerie, his body may be observed twining about in all directions, something like that of a serpent. Indeed, though the animals belong to different classes, there is more analogy between the genus *Felis* and serpents, than one would at first be apt to suppose. They are both carnivorous; they are both awkward in their progressive motion, and they both dart or spring upon their prey with the whole accumulated energy of their bodies; and though the serpent swallows its prey entire, while the *Felinæ* rend theirs to pieces, and even file and grind the bones with their prickly tongues and formidable teeth, there is still a considerable resemblance in their methods of capture.

There is reason to believe that the sense of hearing in these animals is very acute, both from the very perfect development of their ears, and from their habits. Many of them prey only in the woods, and all of them lurk in brakes and thickets, and therefore very quick hearing is essential both to their discovering their prey, and preventing that prey from discovering them. It is also a well-known law in the economy of animals, that those which walk softly in proportion to their weight are always very quick in the ear. This extends even to human beings, among whom it is found that those who walk lightly have quick ears, while a dull ear and a heavy step are always associated together.

What is called the sense of touch appears to be very acute, at least in certain parts of the skin of these animals. The skin of the upper lip, from which the long bristly hairs, called whiskers, grow, is so very sentient as to feel the least bending or touch of any one of those hairs; and by this means they become important instruments in keeping the animal free from contact with obstacles while it is advancing with its eyes intently fixed on its prey. The inside of the ears appears also to be lined with skin of great sensibility, because it is impossible to touch the hairs on these parts so lightly as not to attract the attention of the animal. On the other hand the sense of taste is supposed to be rather weak, because of the particular manner in which the tongue is covered, and also the small supply of nerves with which that organ is provided. It is possible, however, that these suppositions are not very well founded, for these animals show very considerable discrimination, and even daintiness in the choice of their food; and though the callous papillæ on the tongue may diminish the sense of taste in that organ, yet it is certain that the general covering of the interior of the mouth is exceedingly sensitive, as is seen by administering a very small quantity of mustard, pepper, or any other pungent substance to a domestic cat.

There is no question, however, that the grand organ of perception in this genus of animals is the eye. In all of them it is large, prominent, and brilliant, and capable of considerable variations of lustre, and even of colour, in different states of excitement. Some of them have the pupil contracting to a point, and others to a line, though in all it is circular when distended to the utmost size to which it admits. Upon this form, to which the pupil of the eye contracts, it has sometimes been attempted to establish a division of the genus into diurnal and nocturnal preyers. But it does not appear that this is a very legitimate ground of distinction, nor is it easy to see for what reason it should be one. The form of the pupil has really nothing to do with the acuteness of vision, or the quantity of light, which may be necessary for enabling the animal to find its prey. The sensibility of the eye, the small quantity of sight which is sufficient for exciting the retina, is the ground upon which vision in twilight more immediately depends; and a superior degree of sensibility in the retina is in all cases, which are open to observation, attended by a similar sensibility of the iris, and probably also of the whole structure of the eye. It is not because the eyes of nocturnal birds have the iris contracted to a particular form, neither is it because their eyes are weaker than those of diurnal birds, that they see with difficulty in the bright light of the day. On the other hand, it is to the perfection of their eyes that they owe this apparent weakness. The eye, the iris especially, is so powerfully excited by strong light, the tendency of which is always to contract the pupil in the exact ratio of its sensibility, that the eye of the nocturnal bird becomes absolutely closed in bright light, not by the action of the eyelids, but by that of the iris. The same law, of course, regulates the vision of nocturnal mammalia; and, as in the other case, their vision must be supposed to be acute in proportion as they are able to see in a fainter light. The form to which the pupil contracts—a circle, a vertical oval, or a horizontal one, for it has these three forms in different animals, the first tending to close in a point, and the others in lines in the direction of the transverse axis of the oval, has reference not to the necessary intensity of vision, but to the direction of the plane in which the animal has most occasion for a greater range of it. The round pupil contracting to a point is found in animals which have occasion to use the eyes with nearly equal readiness and effect in all directions, vertical, horizontal, or oblique; the eye with the vertical axis is found in those which have most occasion to use their eyes in the vertical plane, especially above them; and the eye with the horizontal axis is found in those which have most occasion to use them in the horizontal plane. Thus in the dog, which ranges the wide field for its subsistence, the pupil is round; in the cat, which, in a state of nature, feeds in the copses, either upon small quadrupeds on the ground under it, or on birds in the branches above, has the greatest power of the eyes in the vertical direction, that is, when they contract they contract laterally, and preserve their vertical range; and in the hare, which has most occasion for view in the lateral direction only, the pupil contracts to a horizontal line. These contractions have, however, nothing to do with the quantity of light which is necessary for enabling the eye to see with the greatest perfection, only a powerful contraction of the iris is never given, except when the eye is a very important organ in the economy of the animal; and, therefore, it is only in such eyes that those differences in the form of the pupil can be perceived. Hence, though some species of the genus *Felis* have circular pupils and others elongated ones, no conclusion can be drawn from these differences with regard to the time at which the animals seek their prey; though there will be found a considerable accordance between the form of the eye and the usual or natural haunt. Thus the lion, which, though he lurks in bushes and thickets, generally preys upon animals which are in the open places, and also has his haunt in places so bare as that he can see what is going on around him, has the pupil round. The tiger, on the other hand, which frequents the grassy bottoms and jungles of much richer places, where the vegetation interrupts the lateral view, has the pupil elongated in the vertical direction.

We shall see afterwards that the structure of the tiger, as well as this formation of the eye, adapts him for those bottoms of tall grasses and reeds in which he is usually found, while that of the lion fits him better for more arid places. In all the genus the pupil of the eye is as susceptible of expansion as it is of contraction; and in all cases when distended to the full stretch it is round.

There is another peculiarity in the eyes of animals of this genus which is but little found in those of most others, that is, the glaring or glistening of the eyes, as if they were really radiant, or shot forth a portion of self-produced light, and also the change of colour which they undergo when the animal is excited, or even when the natural light is faint, and the pupil is consequently much distended. This glistening or glaring colour of the eyes is not peculiar to animals of this genus. It is found very conspicuously in those of night or twilight in other carnivorous genera, more especially in the hyænas, and perhaps there is no animal in which it does not appear to some extent, when the animal is sufficiently excited; but there are none in which it is so remarkable as in the cat tribe, and in them this inward light, so to speak, is so conspicuous, that the name of *cat's eye* has been given to a stone which appears to glisten with an inward light, as though it had a positive luminous power in itself, independently of the light which falls on it.

There have been various speculations about the means by which this remarkable phenomenon in those animals is brought about; and it has sometimes been supposed that their eyes have a power in producing light; and that in searching for their prey in the dim twilight, their own eyes serve them as a sort of lanterns. There is of course no truth in this; and the light which appears to beam from the eye, is reflected from the choroid tissue, which in them has a sort of metallic lustre, which reflects, something in the manner of a concave mirror, a portion of the light which enters at the widely distended pupil. This glaring light is generally different in colour from the light in the eye in the unexcited animal; and as that is in these animals, generally of a yellowish or brownish colour, the glaring light becomes bluish, greenish, or purplish. This change of colour tends in a great degree to explain the way in which the additional reflection of light is produced.

It never takes place except in dim light, and when the animal is excited, and its intensity and change of colour are very nearly in the same proportion as the excitement. Now, in the cameleon and other animals which change their apparent colours in various states of extension of the skin, without any particular reference to changes in the direction of the light incident upon them, it is always found that the change of colour from the natural whitish or brownish yellow to deeper tints, is invariably accompanied, or rather preceded, by an accumulated quantity of blood in the small vessels of the skin. It will be found in like manner, that the strong excitement which causes the glaring in the eyes of the cat family, is always attended by an additional flow of blood towards these organs; and that the difference of colour in the reflected light is always what might be expected from an additional quantity of blood in the choroid membrane of the eye, and deeper in proportion as this quantity may be supposed to be greater. In the eyes of all animals we have the different passions by which they are affected displayed in a manner something similar to this, they all glisten more or less when the animals are enraged; and there are several in which they become absolutely red: of these some of the most remarkable are to be found among ruminating animals, of whose eyes there can of course be no carnivorous lighting up.

It has sometimes been supposed that animals of this genus having eyes with the pupils differently formed, have still the same habits with each other; but it does not appear that this is the fact, though there are instances of species with round pupils, and other species with elliptical ones, being found in the same locality; and in all the other races which contain species having eyes of each of these forms, we find that those with a circular pupil seek their prey upon the ground only, while those which have it contracting to a vertical ellipse seek their prey at least on the lower branches of trees, or on shrubs nearer the ground. The foxes, for instance, which are nightly prowlers, and search for the low-roosting gallinidæ on their perches have the eyes with the pupil elongated vertically; and so far as has been observed, there is no carnivorous animal which has the range of the pupil placed horizontally; though ruminating animals, some of the pachydermata, and even the whales have them constructed in that manner.

We shall only make one other general observation with regard to this very interesting genus of animals, and that is, the comparatively little injury which they receive from falls, blows, and bruises, which would be very serious, if not altogether fatal to almost any other race of animals. "That a cat has nine lives," is a proverbial expression, and, as is the case with all popular proverbs that have come into general use, the foundation of it is true; and it is worth while to ascertain to what it is owing. There is also another peculiarity in which these animals differ from most others, which is, that however they may fall, or in whatever way, they generally alight on their feet, and seldom break their bones, or sustain any other very serious injury.

Now, both of those means of escape from injury, are to be attributed mainly to the freedom or litheness of the joints of the animals, of which notice has been already taken. Whatever part of them is struck, or made to strike against any obstacle always gives way like a spring; and thus the concussion of the blow or the fall is not communicated to any considerable part of them as a direct thrust, but is speedily dissipated and lost among their supple and flexible joints. This suppleness also gives them a command of their bodies in the air, which animals with more rigid skeletons, and especially more rigid spines, do not possess. It is thus that they are enabled in so far to right themselves, even when flung through the air; and the weight of the bones of their fore paws partly conduces to bring them to the ground always with their feet undermost.

That peculiar flexibility of the limbs, to which their twining gait when they walk is owing and the fact of their placing the yielding ball of the foot upon the ground, and not the points of the toes, farther help to let them down easily; and their weight, instead of being all received on one part, is, from the flexibility of the joints, distributed over many. It must not, however, be supposed that there is any weakness or laxity in the muscles of these animals; for their muscles are not only very well developed and energetic, but the freedom of the joints and the large processes of the bones, enables the muscles to act with the very maximum of effect.

Attempts have sometimes been made to divide the genus *felis* into several subordinate groups or sections, founded on the variations in size and colour, and sometimes on mere difference of locality; but these convey but little information which can be of real value, as it appears that all the species are subjeet to very considerable variations of a climatal nature, in the very respeets upon whieh it is attempted to found these groups. There is certainly less variety in the organic structure than in almost any genus whieh is as widely distributed; but if we take the eommon domestie cat as an instance, there is an almost endless variety of eolour, and no ineonsiderable one in size. We shall not, therefore, attempt to define the groups whieh have been formed by different authors, but shall confine ourselves to notiees, and very short notices, of the more remarkable species.

The Lion (*Felis leo*). This is the most famed, and generally described as the most formidable of all the speeies,—the "king of beasts," of whose brave, noble, and generous charaeter, so much is said in the writings of poets and romancing naturalists. But the truth is, that, though there is eertainly physieal power and physieal grandeur in the action of this "animal monareh," there is not any moral good or moral evil. He is a powerful beast, certainly, but still he is only a beast, aeting his part in the physical economy of nature without merit or demerit, and perishing like the humblest of those beasts of which faney has made him the sovereign, when the days of his years of alternate indolence and slaughter are numbered. It is the nature of the lion, as well as of all the other members of the genus that are strong enough for killing large prey, to feed heartily when he does feed, and to fast long in the intervals: so mueh is this the case, that those animals of similar habits at the gardens of the zoological society which had only one meal in the day were found to thrive much better than those whieh had the same quantity of food divided into two meals. The life which such an animal leads is naturally an indolent one; and by far the greater part of it is spent in lolling and repose, at which time there can be but little waste of the system, as the waste in the system of all animals is in proportion to the activity. In prowling for his prey, the labour of the lion eannot be very severe; and although the capture of it is attended with very great exeitement and energy, the time of its continuanee is but short. The lion is thus upon the whole an indolent animal, and when let alone it is comparatively a peaeeable one.

In those places where lions are most abundant, they are seldom seen during the day; and even when seen, if they are not hungry, or attacked, or otherwise annoyed, they do not exhibit any pugnacious disposition, but rather remain in their squatting places, or even slink out of the way. He is not indeed, in any sense of the word, a fighting animal, whieh uses his powers, great as they are, for the purpose of showing off.

Those animals whieh, as one would say, fight for fighting's sake, are seldom carnivorous; and the ones whieh are most so, and have a pugnaeious habit, are probably dogs. And even they, though they worry each other in a state of domestieation, for reasons whieh are not very easily explained upon any animal prineiple, probably fight no battles, save battles of gallantry, when they are in a state of nature. We do not know mueh about them in that state; but it is probable that they are, to a very considerable extent, gregarious; and that, as is the case with most, if not all, gregarious mammalia, the males, are polygamous or rather indiscriminate and temporary in their attachments. All animals which have these habits are more or less pugnacious during the pairing time; and this pugnacity appears to be not wholly without its use in keeping up the eharaeter of the speeies. It is a remarkable fact that, among all sueh animals, the female gives a very deeided preferenee to the stronger males; and the combats of gallantry are obviously eondueive to the same purpose.

Several species of the cat family are also, to a eonsiderable extent, polygamous, or at least indiserimi-nate; and of eourse battles take plaee among the males of them; and it is worthy of being borne in mind, that where such is the case, the male seldom pays any attention to the young, and in many instances is apt to attack and destroy them. Lions are monogamous, always found in pairs, which are attaehed to eaeh other, not merely during the season of intereourse, but for life: and though the greater part of the labour of feeding and proteeting the young, during the comparatively long period which they require to arrive at maturity, falls upon the female, it does not appear that the male treats the young with any positive hostility. How often they breed in a state of nature is of course not known; because the acquaintanee whieh man forms with lions in a state of nature, is neither very long nor very intimate. It is probable, however, that owing to the length of time whieh the eubs require before they come to maturity that the breeding is not every year, or even every second year; and it is probable, though not proved, that when the young are able to provide for themselves the old ones may drive them from their haunts, in the same manner as is done by eagles; for lions are seldom met with in more than a single pair in one plaee, unless when there is a lioness and her cubs.

The lioness goes about four months with young, and the eubs when dropped are of a very small size, and without any indication of the mane or the terminal brush on the tail of the males. They are not born blind; but their ears are soft and partially dependent, and they are without eanine teeth or retractile claws, the arms upon whieh they ehiefly depend for their subsistence when full grown. There are also certain markings of colour in the cubs which show that there is some natural affinity between lions, at least in their young state, and the striped and even the spotted members of the genus. The young lions have a blaek line down the baek, and transverse bars alternating with spots along the sides. These stripes and spots are obscure, and they are gradually obliterated; but they are general, and belong equally to both sexes, while young. At the age of about twelve months, the canine teeth of the eubs make their appearance; and judging from what happen from lions in a state of confinement, it is supposed that the cutting of those formidable teeth is a very trying time with them. In about a year and a half, the elaws acquire their retractile eharacter; and soon after the cubs begin to play the lion on a small scale; but the mane and brush do not appear till the end of the third year, nor do they arrive at full maturity till the end of the fifth. When full grown, the lion measures about eight feet from the point of the muzzle to the insertion of the tail, and the tail is about half that length, and generally ends in a small spine or claw on the middle of the brush; but this spine is attached to the skin only, and not to the terminal vertebræ of the tail; thus it is easily worn off, but whether in such cases it is again reproduced, has not been ascertained.

Some general notion of the form and bearing of the lion, when standing at gaze, or not excited, may be derived from the figure at the top of the plate "CATS;" but no figure or description can adequately represent the excited animal in full nature.

The general colour of the lion is tawny yellow, with the mane and the brush a little darker, and more inclining to sooty black, and there is generally some trace of the dorsal line remaining. The naked skin about the muzzle, and the pads on the paws are dark coloured, but not a deep or entire black. It is not very easy, however, to describe lions by colour, for they are subject to considerable variations in different places, and perhaps also in different individuals of the same locality. Thus, in Southern Africa there are lions with the mane nearly black, and very shaggy, while those which are found in India are all over of a uniform yellow colour, and have comparatively little mane.

The range of the lion, as at present found, may be described as extending from the secondary hills on the south of the Himalaya to the southern extremity of Africa, though it is not very probable that they are met with to the north or east of the great Asiatic chain of mountains. In the earlier periods of history we have evidence that they were plentiful in all the more thinly-peopled districts of Asia, to the south of the great central ridge; and that they were both frequent and dangerous visitants in some of the more inhabited places. In those times, that part of the world was much more fertile than it is at present; and that though many parts of it were much more thickly peopled than they are now, the intermediate places between the different kingdoms and states, which were comparatively small, and at very frequent hostility with each other, were of a very different character from the deserts which are now to be met with. We have evidence that there was much more cover for lions, and, which is more to the purpose, more food for antelopes, wild asses, and those other animals of comparatively warm and dry, but not absolutely barren places upon which lions chiefly subsist. There are accounts by the ancients of lions being numerous in Syria, and even in Asia Minor; and it is possible that they existed in the middle ages, and may still exist in many places of that country where they have not been observed. The name of the lion is a familiar one in all the languages of the nations throughout the whole extent which we have mentioned as forming their range; and the case of India is one which should make us pause before we decide, that there are no lions in the wild places of those countries where there is cover and food for them. In the days of the glory of the Indian empire, when the country was very generally peopled and cultivated, lions had long ceased to be met with, and they were described as being wholly extinct. But it appears that the remains of them had been only banished into the most inaccessible and least known parts of the country. For no sooner had the internal wars, by which India was so long disturbed and distracted, depopulated large tracts of the interior, and allowed them to revert to a state of jungle, than the lions made their appearance, and afforded a complete proof that, though reduced, they never had been exterminated. But they keep more in the wilds than tigers, and are neither so bold nor so active, though their spring is more terrible, and their teeth and claws more powerful; and thus they were not seen while people were but too familiar with the ravages committed by their congeners.

All the power of the lion, great as it is, is concentrated in the fore part; and though the stroke or the clutch of the paw, at close quarters, is rather a serious matter, the lion in free nature is, like the birds of prey with their stoop, truly formidable only in his spring.

The roar of the lion, for the production of which there is a very peculiar organisation of the throat, is very terrific,—deep, solemn, and heard afar, and startling to all the animals of the wild. It is not uttered during the day, at least till the sun is set, or nearly so; and it is said to be given most powerfully when the evening sky is murky, and the clouds threaten a storm during the night. These are favourite times for the grazing animals which form the lion's prey, and it is said that he betakes himself to an eminence, and sounds his terrific battle charge, in order to startle those animals, and enable him to find out the place where they are by the sound of their feet while they attempt to trot off to places of safety. But after the roar has given him the necessary information, the lion steals softly and silently upon the sound, crawling upon his belly from bush to bush, or from thicket to thicket; and the unsuspecting herd are not aware of their danger till the yell is given, and contemporaneously with that, the spring is taken, and the victim secured.

Unless when wounded, irritated, or pinched by the extreme of hunger, the lion does not attack parties and caravans with the same boldness and determination as the tiger. But he will follow, stealing and prowling for a much longer distance, and the nature of his haunts require it, as they do not abound so much in cover as those of the tiger.

There are numerous instances mentioned of the courage, the kindness, the docility, and many other qualities of the lion in a state of confinement; but all these are of little value in the natural history of the animal; and therefore, though space admitted, we should hardly force them upon the notice of our readers. They of course do not in any way alter the character of the lion; though they may be received as additional proofs of the otherwise well-established and indeed self-evident proposition, that the powers of the lion are never brought into play unless there is a sufficient exciting cause; and the same may be said of every other land animal with which we are acquainted.

The majority of those animals which civilised man can domesticate with advantage, must, however, always be those which feed upon vegetable matter, whether their labour or their flesh be the object for which they are domesticated. This follows as a necessary consequence of the cultivation of the ground always being the chief means to which civilised nations must have recourse for their support. In this respect, the vegetable-feeding animals and man work well together—because the refuse of human food answers in part for the food of those animals; they supply manure better adapted than any other for increasing and preserving the fertility of the fields; and those plants which are more exclusively used for food to such animals, instead of exhausting the land, improve its condition, and render it more productive of human food than it otherwise would be.

Carnivorous animals, on the other hand, are of no use in these respects; and therefore the different varieties of the dog, and the domestic cat, are probably all that can be bred in a domestic state with any advantage; and though it may be necessary to keep a few individuals of all the other species for the purpose of promoting the knowledge of nature, yet the number of these must always be limited; and, as even this limited number cannot be considered as part of the domestic creation, it is only a very limited portion of their history, and that portion, far from the most interesting part of it, which can be obtained from them in that state. If we would see them in their true characters, in whatsoever of grandeur or of any other striking attribute they may possess, we must seek them in their native haunts; and the more powerful that they are, the farther are they removed from the habitations of man.

This is peculiarly the case with the lion. Africa may be regarded as the wildest portion of the eastern continent; and therefore it is in Africa that we can see the lion in all his majesty, and have a proper conception of the physical powers which this animal possesses. In many parts of that continent his dimensions considerably exceed those which have been mentioned as the average in the preceding part of this notice, the length being sometimes more than nine feet, and the height nearly five. The lioness is generally about three-fourths the size of the male in lineal dimensions, and being without the mane, she does not look nearly so formidable. The mane of the lion is not confined to the upper part of the neck, but surrounds it on the sides, and even on the chest below. It is very closely set; and the hair of which it is composed is, in the largest specimens, more than two feet in length. This formidable clothing is with difficulty penetrated with any ordinary weapon. When the animal is prowling or using only his common powers of locomotion, in the use of which he is generally slow and majestic, this mane lies a considerable way over the back, hangs down over the shoulders, and thus protects the powerful muscles which put his destructive arms in motion from all changes in temperature, so that they are never stiffened by cold or relaxed by heat, even when he finds it necessary to prowl in the open deserts, either during the night or during the day. There is a beautiful adaptation of nature in this particular part of the covering of the lion. On the African deserts, the heat, even far without the tropics, is excessive during the day; but during the night the cold is often much greater than would readily be supposed. This is in great part owing to the excessive heat of the day and the dryness of the surface. The reflection of the ground makes the lowest stratum of the air as hot as an oven; and as the capacity of the air for moisture increases more rapidly than even the temperature, its thirstiness during the day is greater even than during the heat; but after sunset the air becomes cold, and its tendency to part with the moisture which it holds in solution increases faster than the cold, so that dew forms in the air itself, and instead of being produced on the surface of the ground, as it is in colder latitudes, it is actually evaporated by the ground, and this evaporation, where the ground is negative of vegetation, produces in the night air a degree of chilliness, by which travellers in the desert often feel themselves much more benumbed than if they were abroad in the night during a Lapland winter. On nights of this description, the male lion is often on the prowl, and the prey hovering in the neighbourhood of the caravans, which usually have their camels ranged in a circle round them, or in quest of the antelopes and other animals which are couched on the desert for the night. When he watches the caravan he prowls in silence, and never betrays his presence by a roar, or even by the sound of a foot fall, until he is sufficiently near for taking his spring; and then the yell and the capture of the victim are instantaneous, and he has gone, prey and all, before resistance can be offered. But when he ranges for the wild animals of the desert during the night, his conduct is different. He then roars; and in doing so he brings his mouth very near to the surface of the ground, by which means the roar is heard to a greater distance, and he is better enabled to hear the sound of the alarmed animals, when that terrible war note is sounded. Even the lightest antelope, being a hoofed animal, and with its hoofs hard, makes a considerable pattering on the sand, especially when it bounds in terror at the voice of the lion; and thus the quick ear of that animal is not only enabled to ascertain the direction, but how far the animals run, and where they halt, and thus he can come with his silent and stealthy pace, till he is within that distance at which the capture of them is certain. During the night, those animals do not, and cannot run very far, because they are in so far benumbed with the cold, and that cold exhausts them on their march, as cold is observed to do with horses during a keen frost. The lion, however, protected he is by the mane, is subject to no such calamity. The muscles which he uses in his prowling march are strong, and they are so slowly used as not be in the least heated or fatigued, when those which he has to use with greater effort while he springs, are secured by the thick covering of matted hair, which invests the neck, shoulders, and chest. The lioness, in general, prowls less in the open desert than the lion, and therefore the same kind of protection is not so necessary in her case. She is chiefly in the thicket, at or near the den; and it is understood that till the young are able to find the greater part of their own food, the plunder which the male makes during the night is carried thither as a common meal to the whole family; and the strength of the lion is such, that he can carry off not only one of the largest antelopes, but a wild ass, or even a buffalo, when he has torn out the entrails of the latter, upon which he usually feeds before carrying the carcass to the den.

It is not, however, when prowling in these deserts by night, and during the dry season, that the action of the lion is upon the grandest scale. He is more majestic in the majesty of scenes, and also in the majesty of the elements. The lion is not in all probability much of a migrant; and though he shifts his ground according as prey is for him to be found, it is not probable that he follows the great herds of migrant animals of Southern Africa throughout the range of their whole migration. When the plains are so completely burnt as to afford no pasture, and all the water has disappeared from the smaller streams, lions cease to frequent the thickets on the margins of the pastures, or those by the sides of the usual watering places of the migrant animals while the plains remain fertile; but on those occasions they betake themselves to the neighbourhood of perennial rivers, or to the forests of acacias and other trees, where there are still food and browsing animals. In the former places the larger antelopes and buffaloes are to be met with; and in the latter the giraffe, an animal which subsists chiefly upon the leaves of trees. The antelope is an easy prey; because the spring of the lion is sufficient at once to dislocate the spine of that animal, or to fell it to the ground; but the buffalo and the giraffe are a prey which require more art in the capture. It is true that several species of the antelope will attack the lion boldly, and transfix him with their horns if they find him in the open plain; but if he can spring upon them they are incapable of resistance.

The buffalo and the giraffe must also yield if the spring is rightly taken; but they are much stronger animals, and unless the lion can grapple at once with the muzzle of the buffalo, the skin of that animal is so firm, and its muscular powers so great, that it is able to shake off the lion, and turn and toss him with its horns, and trample and kneel him to death, before he can make his escape. He therefore springs upon it so that he can retain his hold on the shoulders with the hind feet, and grasping the muzzle and chin with his paws, wrench the neck aside till it is dislocated, or till his weight, acting on the lever power thus obtained, throws the animal down and enables him to despatch it by tearing the throat. This mode of attack requires the spring to be taken with more certainty, and also rather at a shorter distance than is necessary in the weaker animals; and consequently it requires more lying in wait. Buffaloes are also animals of very keen scent, and hence it is probably necessary that the lion should "take the wind" of them. They are also strongly excited by the sight of blood; and thus they are never in such repose near where the marks of former slaughter are to be found as that the lion can with certainty attack them. Thus, buffalo hunting is one of the hardest occupations of the lion, and consequently one to which he never resorts, while any other can be carried on.

The giraffe is not so formidable at close quarters as the buffalo, but still there are difficulties attending its capture. Its feeding grounds are not the most tangled parts of the forests, but rather those in which the surface of the ground is comparatively clear, and the trees on whose foliage the animal feeds at some distance from each other. He cannot steal upon the giraffe so as to spring at it in front, because, in that case, he would merely catch the tree, and the animal would escape beyond his reach before he had so far recovered himself as to be in a condition to spring a second time. There are also difficulties in an attack on their rear. From the position of its eyes the giraffe commands the view behind it much better than that before, especially when it is feeding, with its long neck extended upward to the branches. There is also a very powerful weapon, as well as a watchful eye, in the rear of this animal; for its hind leg, though much shorter than the fore one, is yet so long, and it can strike out with so much rapidity, that a single blow taking effect, would fell the lion to the ground, or even fracture his scull. This animal has therefore to be taken by stratagem, more so perhaps than even the buffalo; and it is chiefly when it resorts to the water, and is in the act of drinking, that it becomes the prey of the lion. Long as its neck is, it has to place the fore feet at a considerable distance from each other in order that it may reach the water, and the position of its head when so doing prevents the use of the eyes and the ear. Thus it is incapable of observing the approach of its enemy, and it is not in a good attitude for striking with the hind foot, although it could see him.

The places where water is found in the dry season, which is the chief time at which the lion preys on the giraffe, are, generally speaking, rather favourable for the attack of the lion. African rains fall so fast, and flood the water-courses so suddenly and to such an extent, that these are deeply worn, and in many places present rocks and hummocks high above the surface of the water in the dry season. On these the lion takes his post at the usual time when the giraffe comes to drink; and thus he is enabled to fling himself on the body of the animal, and tear its flesh with both claws and teeth, while it darts off at its swiftest pace. But it has no means of shaking off the spoiler; and thus, as the giraffe is not a very swift animal, the fatigue of the flight, the weight of the lion, and the agony produced by the action of all his lacerating instruments, speedily bring it to the ground, where it is soon in pieces. It is impossible to know experimentally what is the degree of pain occasioned by a lion riding on an animal and rending it all the time; because no one can feel that terrible infliction and survive to give any account of it. But if we may judge from casual wounds given by the clutch of one paw, or even of a single claw, we can easily perceive that it must be among the most terrible tortures to which the living body of an animal can be subjected, in consequence of mechanical laceration; and it is *possible* that, as the breath of the lion is peculiarly offensive, that there may be some quality in that, or the saliva, which may increase the irritation and agony of the wounding. The mechanical action is, however, of itself sufficient to produce great pain, by all the instruments which are at work for the destruction of the victim. The claws and the great canine teeth have all, to a certain extent, angular or tearing ridges, sharp enough to wound, but not so much so as to make a clean wound, while the tearing teeth, both by the form, and the double motion of gnashing them against each other, and writhing the bite, must much increase the pain to the animal; and it is possible that the abrasion produced by the tongue, with its thickly set and sharply pointed hooks, may not, after the skin has been divided to a considerable extent, be among the most painful parts of the process. There is this advantage, however, that not the most powerful animal can live long under the claws and teeth of the lion.

It is, however, when the elements are in all their grandeur, that the lion appears to be most in his glory and in his element. It has been already mentioned, the favourite times for the roaring of the lion are about sun-set, or a little after, upon those nights of lurid and portending skies, where there is every probability that the resistance of the lower atmosphere will give way, and the storm break about the turn of the night. We find that the portending storm, after long drought, produces an unusual stir among the animated tribes, even among those of our peaceful climate; and it will readily be understood, that where things are on so much grander a scale as they are in Southern Africa, the excitement must be proportionally great. The fresh activity thus displayed is, on the part of the animals, a grateful though instinctive anticipation of the plenty which is to be the consequence of the storm, and we must suppose, that as the lion is part of the system, he is affected in common with the rest, Indeed his share comes first, and in this respect at least he deserves his common title of king of the beasts; but this enjoyment is death to the rest; and as they are thrown off their guard by the excitement of the time, he is enabled to commit far more havoc than usual; and, as if he loved the sport, he, on these occasions, is said to kill far more than he is able to eat.

The first part of the storm consists of lightning and thunder, the former very vivid and the latter correspondingly loud; and both are so incessant, that the eye of the excited lion would glare, and his voice roar, in vain, either for the alarm of any animal or for the warning of its danger. The wondering animals crowd into masses and stand exposed in the open places, betrayed to the eye of their murderer by the incessant gleaming of the lightning; this continues after the clouds have given way, and while the wind blows in hurricanes and the rain falls in floods.

It is but seldom that men have the opportunity of beholding these sublime displays of natural power; but sometimes the lions get so excited and emboldened upon those occasions, that they attack the domestic animals close by the habitations of remoter colonists, and carry their war into the heart of the villages of the native Africans, to make reprisals for the injury done to them by the poisoned arrow and the assagay in more peaceful times. Thus it is in the midst of the mightier commotions of nature, when man must keep within his shelter, when all appears going to wreck, and when much is actually so going, that the power of the lion is fully displayed.

We shall close our notice of this much, long, and not unjustly celebrated animal, with only a few short observations. There is this resemblance between the lion, which, when he has the advantage of his spring, is unquestionably the most powerful beast of prey, and the eagle, which, when she has the advantage of her stoop, is as unquestionably the most powerful of predatory birds, that in all cases where the stroke, or the clutch of the claws, is sufficient to occasion the death of the prey, that prey is never touched with the mouth until life is extinct; whereas in the less powerful animals of both classes, the mouth is called in to assist the other weapons from the very beginning of the attack. Farther, the lion's whelps, before they have their tusks or their protractile claws, are exceedingly playful; and they are suckled for about twelve months. The lioness is naturally much weaker and also milder of disposition than the lion, and does not hunt so large prey for the supply of her own appetite; neither does she prowl so much by night in the bare and dry deserts, or play so bold a part during the breaking of the storms. But her attachment to her young is very strong, and in defence of them, or in quest of food for them when they are hungry, she is quite as ferocious and even more indifferent to personal danger than the lion himself. When lions are young and vigorous, they seldom appear without the brakes and forests; but when they grow old, and are incapable of so constant or so powerful motions, they venture nearer to human habitations, and prey more upon domestic animals, which are less fleet and also less fearful than wild ones. When the male lion is not excited, he is not dangerous to man nor any animal; and when a traveller comes upon him, either couching in a thicket or pacing slowly and carelessly along, if, after his eye has caught the traveller, his mane and tail remain motionless, he will do no harm unless irritated; but, if his mane begins to stand on end, and his tail to be erected, and especially to lash against his sides, these are sure signs that he is working himself up for mischief. The age of the lion, in a state of nature, is not exactly known. In confinement, it has been ascertained that some individuals have lived to the age of seventy years; and it is at least probable that, when free from restraint, he may live considerably longer. The number of young in a litter is not very well ascertained; but there have been instances of as many as nine in a state of confinement, and it is reasonable to suppose that the broods should be more numerous, rather than fewer, in a state of free nature.

Though the lion has probably more powerful muscles than any other of the mammalia, those muscles have not the same firm and rigid character as those of the eagle. The reason of this is, as it should seem, that their powerful action is much more momentary.

The flesh of the lion is certainly not so delicate as that of less energetic animals, as the coarseness of the muscular fasciculi is generally in proportion to the power of action in animals; but the toughness is more in proportion to the constancy and continuity of their action. In Africa, the Negroes occasionally eat the flesh of the lion, and some Europeans have pretended to like it—but the general report is that it is rank and disagreeable. The skin does not come under the usual denomination of fur, as the hair is short and rather coarse; but it is tough and durable. The ancients were fond of it on account of the fabled heroic account of its owner, and they made it a robe of distinction for their heroes; but the heroes of modern times prefer the skins of the more showy members of the genus, and these they use, not as ornaments for their own bodies, but as caparison for their war horses. The natives of Africa use it indiscriminately as a mantle and as a covering for their beds, and in both cases it is very durable.

THE TIGER (*Felis Tigris.*) Next to the lion, the tiger is the most formidable of this genus; and as it is a much more generally active animal than the lion, and consequently a much more frequent feeder, it is more destructive and also more dangerous. The danger is increased by the nature of the places which the tiger frequents. It is not, like its congener, an inhabitant of the desert, but of the rich jungles, where prey is to be found at all seasons; and as these are more in the vicinity of human habitations than the favourite localities of the lion, many more human beings fall victims to the rapacity of the tiger.

A very spirited figure of the tiger, in form, in markings, and in attitude, is given in the plate "CATS." This figure is not in the attitude from which the tiger takes its spring, but in that of advancing in a low and crouching attitude in order to gain the distance at which he shall take it; and this is perhaps the best for displaying both the litheness and the symmetry of the animal. It will be seen in the figure, which is equally faithful and spirited, that the tiger is a much more symmetrical animal than the lion; that, though the fore paws are still stronger and more firm in their texture than the hind ones, yet, that the strength of the tiger is more uniformly distributed over the whole length of his body than that of the lion; and consequently, that he is much more an animal of chase.

The name *Tiger*, in the Armenian language, means an arrow or javelin, and the Hindoo word *Tippoo*, which is the general name of the tiger in the East Indies, has much the same signification, as it imports "that which rushes impetuously and irresistibly." The river Tigris is so called from the swift and arrow-like rush of its current; and it is not uncommon in India to give the name of Tippoo to bold and relentless warriors, of which Tippoo Sahib was an instance; and it is worthy of remark, that while Tippoo, or the Tiger, is the name for a great warrior or a powerful chief in the southern parts of India, Singh, or the Lion, is the name for the same sort of personage in the northern parts. This difference of name is important, as pointing out the geography of the animals; the epithet Singh being used only to the north of the central height and the Nerbudda, and the epithet Tippoo only to the southward; thus marking the tiger as a more southerly and easterly inhabitant than the lion, and also the inhabitant of more fertile districts, though tigers are occasionally met with in the country of the lions, and lions, though more rarely, in the country of the tiger.

The length of the tiger is rather more in proportion to the whole size of the animal than that of the lion, and the tail is also rather longer; the length of the body sometimes exceeds nine feet, and the tail is about five feet in length; the legs are rather shorter, and the animal bends them more, and has more of the snake-like flexure of the spine when he walks. The head is less square than that of the lion, the features are not so grim and formidable to appearance; the cheeks appear much more rounded, which is in part owing to the thick fur with which they are covered, and the absence of the eyebrows and the mane cause the animal to look less ferocious than the lion, though, in reality, he is equally so, if not more. The absence of the eyebrows and mane indicate a difference of habit in the animal, and this difference is farther pointed out by a difference in the structure and appearance of the eyes themselves. The shaggy mane of the lion defends him, as already observed, from the great changes of temperature to which the nature of his haunts exposes him; and as, during the dry season, even the bushes among which he resides afford him but little shade from the rays of the perpendicular sun, the projecting brow makes up the deficiency. The richer vegetation and more expanded foliage in the haunts of the tiger, render those protections unnecessary in his case; and thus, as nature is never redundant any more than she is defective, the tiger is not furnished with these. The pupil of the lion, which, when he ranges in the strong light, which he seldom does in exposed situations, contracts to a circle even in its greatest contractions; but that of the tiger, though round when distended, and even when moderately open, closes to an oval and almost to a short line in very strong light. This form of the eye enables the tiger to see above him when he springs upward, and below as he descends when he is bounding through the tall grass of the jungles, and thus his whole muscular exertion is, on these occasions, left to the general movement of his body. In consequence of this consent of the whole body to the one species of action, the tiger is, according to a very general law in animal mechanics, enabled to bound through the jungle a long time without being fatigued, though the character of its vegetation requires that each bound should be taken very high, and for a distance proportionally long. The flexibility of the joints, and the readiness with which the spinal column arches and extends itself in accompaniment to the legs, tend greatly to lessen the labour of the tiger's march in these places, and thus the tiger can keep in motion for miles, in situations where the lion, notwithstanding all its strength, would be exhausted by a march of a single furlong.

The ground colour of the upper part of the tiger is straw yellow, of much richer tint than that of the lion, and passing into pure white on the under part; the whole is beautifully marked with cross bars of black, of a spindle shape, or broader in the middle than at the ends; and, where they run to considerable breadth, the middle of them is often relieved by a narrow streak of paler tint, sometimes approaching to the yellow of the ground colour. These markings vary considerably both in number and in size in different specimens, but they always contract very strikingly both with the yellow and the white. The ground colour of the tail is intermediate between the deepest yellow and the purest white of the body, and finely, and in general very regularly annulated with black. The interior of the ears, a space round the eyes, the cheeks, the throat, and the muzzle, are also white, and there is a white soft and thick fur projecting forward on the under part of the chin. The eyes, when the animal is in a state of repose, are more yellowish in the tint than those of the lion, and when it is excited, and they glare, they have more of a greenish cast. The absence of brows and the rounded form of the head, make the eyes stand out more than in the lion; they are also more restless, and when the animal is incensed they are probably more terrific.

As the male tiger has no additional furnishing of hair, excepting perhaps that on the cheeks, and the chin is a little more produced than in the female, there is much less difference of appearance, and also of strength and of habits in the sexes, than there is in lions. But still the tigress is, upon the whole, a milder animal than the tiger, unless when she has cubs, at which times she is perfectly ferocious in their defence. The period of gestation in the tigress is not ascertained with perfect accuracy, neither is it known whether the duration of it may not be, in part at least, modified by circumstances, though such modifications can of course take place only to a very limited extent. It is generally understood to last between three and four months. As predatory animals are much less dependent on seasonal supplies of food than those which live upon vegetable matter, their breeding times are not so strictly confined to definite periods of the year; and as, in the richer parts of tropical countries, the difference of seasons are very slight, even the birds are quite miscellaneous as to the periods when they build their nests. This being the case, we may naturally suppose that tigers, which invariably inhabit rich places, breed indiscriminately at all times of the year. We have a very striking instance of this difference of breeding in the case of herbivorous and carnivorous animals, and also in the differences of different genera of the former in our common domestic animals. The horse is pretty constant as to breeding time, and so are sheep and cattle when they are left exposed to the weather the greater part of the year; but dogs and cats have no fixed season, but produce young indiscriminately, summer or winter, spring or autumn. In the case of the horse it does not appear that difference of treatment very much changes the period of breeding, though in proportion as the climate is warmer, and they are better fed, they upon the whole breed earlier. Cattle and sheep, especially the former, are much more obedient to circumstances. The natural period for sheep to bring forth is in the spring, earlier than that of cattle, but by management the time may be carried forward into the winter; and thus we have house lamb fit for the table, a month or two before the time ewes, left exposed to the weather, drop their young. In the case of cattle again, this period may, by management, be extended over the greater part of the year, so that if there is a demand and a price for it, veal may be had for the market at all seasons. It is natural to suppose, however, that these young animals, bred out of the natural times, are neither so racy nor so wholesome as those which are produced at the natural period, just in the same manner that animals of which the fattening is forced by indolence and cramming, are never so wholesome and so savoury as those which have the free range of good pasture.

In those circumstances, simple as they may appear, there is a good deal to be learnt respecting the geography of the animals; and this, when we can get any satisfactory clue to it, is always a very important matter, as affording more insight into the general history and economy of nature than we can obtain by any other means. It will readily be understood and admitted, that no domestication or artificial treatment can wholly change the nature of any animal any more than it can change the organisation; though it may so far obscure the original character, as that it may escape the notice of ordinary observers.

In devoting one short paragraph to this important point, which we can better do here, where it has arisen naturally, than if we had written a separate article on the subject, the technical name of which might have prevented those for whose benefit it is intended from reading it;—in devoting a single paragraph to this point, we shall put carnivorous animals altogether out of the question. When we do so, we find that the others point very plainly, if not to their original latitudes, at least to the kind of surface upon which we might expect to find them in the wild state. The horse, as the least obedient to cultivation in this respect, evidently points out a native locality in those dry plains in the middle latitudes, which have the alternate seasons of fertility and barrenness strongly marked; and these are exactly the places in which analogous races of animals are still to be met with in the wild state—the plains of central Asia for instance, northward of the line of the Hindoo Kosh. The sheep, which are a little less seasonal, or are more easily diverted from the proper season by artificial means, point out a native locality where the succession of the seasons is less uniform; and there is some reason to believe that the parent stock of our domestic breeds is the moufflon of the mountainous parts of the south of Europe, and especially of the islands in the Mediterranean. As in so far corroborative of this fact, it has recently been ascertained, by experiment in Malta, that the moufflon will breed with domestic sheep. The ox again, which in this respect is the most obedient to art, points exactly to those places where animals of the genus are still met with abundantly in a wild state,—the humid plains of the middle latitudes, where vegetation is nearly or altogether perennial.

Tigers are, as we have said, more independent of this seasonal influence than almost any others even of the carnivorous animals. They not only inhabit the warmest latitudes, but they inhabit the most fertile places of those latitudes; the regions, in short, where the vegetation is in continual growth, and where, in consequence, those animals upon which tigers prey find plenty of food at all times, and are in consequence very numerous. It does not appear that the tigress is so productive at a single litter as the lioness, but it is probable that she breeds oftener. Four or five is the usual number; and when they are produced they bear a very considerable resemblance to young lions, though it is probable they come rather sooner to maturity, and are perhaps not quite so long lived. The life of animals is very generally, though not invariably, in the inverse ratio of their activity; and, upon the whole, the tiger is a much more active animal than the lion. Savage as those animals are when they are hungry, or when alarmed or irritated, there is no animal more attached to her young than the female tiger. The determination with which she will fight in their defence, and the dangers which she will encounter to prevent them from being taken, or to recover them after they are taken, are truly wonderful. On such occasions she will enter a city, or encounter a whole army; and when she does not succeed in recovering her offspring, her cries are the most piercing, and also the most piteous that can well be imagined.

The cry of the tiger, even upon ordinary occasions, is much more appalling and even horrid than the lion. There is grandeur in the deep and full tones of the latter animal; but there is neither majesty nor music in the voice of the tiger. It begins with deep, slow, and melancholy growlings; these gradually become more acute and hurried, till they terminate in a piercing cry, of which no description can be given, and this cry finishes with a convulsive jarring, as if the rocks around were shaking to pieces. This voice is very loud, and when it is uttered in the forests, it is so repeated in echoes, that the roaring of one tiger is heard as though the place were surrounded by numbers of them. These cries are generally uttered during the night; and, blended as they are with the yelpings of jackalls and hyænas, and the alarmed cries of all those beasts and birds which are terrified at the sound, they render night in the tropical forests any thing but a season of repose. Nor fares it much otherwise in the early part of the morning; for no sooner have the beasts of prey become silent, than the larger quadrumana begin their howling; and when they cease, the chatter of the monkeys, and the screaming of the tree birds, keeps the forest alive all the remainder of the day.

The countries around the Bay of Bengal, with the larger islands of the Malay peninsula, are the principal habitations of these formidable animals; and they appear to be large in size and powerful in action, in proportion as the ground which they inhabit is fertile.

There is, perhaps, no river in the world which has made so extensive deposits in the lower parts of its valley, or where the portions near the sea are so closely tangled with vegetation, or so thickly stocked with animals, as the Ganges. The Sunderbunds, or islands formed between the different mouths of the

Ganges, and the name of which signifies a forest of rapidly-growing trees, form altogether a triangle, each side of which is nearly two hundred miles in length, or altogether it is not much less than England. This may be considered as *par excellence,* the demesne or park of *Tippoo,* in which he reigns in splendid but ferocious majesty. It is true that he has some subjects who do not very much regard his sway upon ordinary occasions, but these are not exceedingly numerous. The elephant and rhinoceros are both met with in this singularly blended scene of life and death ; but the ground is rather soft for their heavy tread, and they are consequently but rare. The gavial, or crocodile of the Ganges, is however exceedingly numerous, and very large ; and though but a slow and sluggish animal upon land, it often makes prize of the tigers when they come to the waters to drink. But, with the exception of the three species now mentioned, the tiger lords it over all the animals of this wide region, and very often issues from it to invade the plantations and even the villages which are in its vicinity. Swamps and jungles of smaller dimensions are formed by the back water of all the greater rivers of India, and indeed in every place where the water stagnates ; and where such jungles are formed, tigers are always to be met with. The greater number of them keep within their jungle, because the woody jungles are generally interspersed with grassy ones, in which deer, antelopes, and other animals pasture ; and the woods themselves afford an ample supply of wild hogs, monkeys, and other animals, of all of which the tigers make prey. Sometimes, however, they issue from their fastnesses ; and as when they do so they are generally in a state of great excitement, they commit terrible ravages, and are generally destroyed by the people rising *en masse* to hunt them, and those hunts, as well as the hunting of the tiger for sport, are attended with no inconsiderable danger. When they make these inroads into the habitations of men, or of tame animals, they kill much more than they eat ; and it has thence been concluded that tigers are endowed by nature with a love of slaughter unknown to any other animal. It does not appear, however, that this is the case ; for though the tiger comes more into the settled and peopled grounds than the lion, yet he is not exactly in his native element there, but is excited, and generally also alarmed, and therefore he does not rest to eat what he kills, but goes on attacking and killing indiscriminately. In his native jungles, there is no reason to believe that he commits murder for the sake of murder, but simply that he seeks his food according to the general law observed by all animals ; and that, when fed, he is in repose, and quite harmless, as well as the rest. Tigers are much more numerous in those jungles than perhaps any other beast of prey is in any part of the world ; and as the individuals are all very like each other, it is possible that this character may have arisen from one tiger getting credit for having done that work which was really the performance of a dozen or more.

Many of the islands and muddy banks in the tiger's country are held as sacred by the superstitious Hindoos, and as such, they are resorted to by devotees. These devotees very often fall a prey to the tigers ; but as not a few of them go to such places for the express purpose of seeking death, it is possible that death by a tiger, by being more brief, is attended with less real suffering than starving to death in a region where the atmosphere is pestilence. When the water is high, and boats can pass near the trees which cover these islands, such approaches are highly dangerous, because a tiger will spring for a very considerable distance from the jungle upon a boat full of armed men, and make off with one of them before the rest have time to offer any resistance. Even when parties of mounted soldiers ride too close to the tiger jungles, the tiger will sometimes spring, seize a horseman, and be off with him almost before the others are aware of it.

In places which are not so humid as the jungles of the Sunderbunds, tigers do not attain the same size, but they are more active, and on this account more dangerous to the inhabitants. In the larger islands, Sumatra and Java especially (we know less of the interior of Borneo), these animals are highly destructive. They not only intercept the people in journeys through the woods,—and, from the nature of the climate, the greater part of the surface is either wood or cultivated fields,—they also carry them off not only from their field labour, but when they are busy at the doors of their houses, and even when they are inside. They will sometimes descend or issue from the woods in a troop upon a village, and destroy the whole inhabitants ; and there are many places of those islands where, from a sort of foolish superstition, the people take no pains to thin their numbers. The general superstition is, that if they make a wanton aggression upon the tiger, he will wage a war of extermination against their family ; but, on the other hand, if the tiger is the aggressor, they conceive themselves entitled, in as far as they are able, to wage a war of extermination against him. There is no doubt some show of iniquity in this tacit code, but the misfortune is, that only one of the parties can be made to understand and obey it, and that thus it induces the people to spare those animals to the destruction of many of their own lives ; the more so that, from the nature of the country, there is cover for tigers in the close vicinity of almost every village. The people are not, however, without dexterity in the capture or destruction of tigers, when once they can be induced to undertake that operation. Sumatra and Java are, generally speaking, too tangled with woods for admitting of tiger hunting, even with the assistance of elephants ; and therefore the people have recourse to traps, pit-falls, and gins, in the formation of which they display no inconsiderable ingenuity.

Though the tigers of these islands are not so heavy as those which are found in the jungles of Bengal, they are exceedingly strong, as well as active. It is reported that they can break the leg of a horse or a buffalo, not by the force of the spring, but by the mere stroke of the paw, while the bite is sufficient to hamstring and cripple an elephant, and they are said to aim at that part of the animal. But the elephant, in a wild state, is seldom to be taken unawares in this way ; and if it must receive the spring of the tiger on the hinder part (and the tiger will not attack an elephant in front, unless by surprise), it crouches, and receives him on the upper part, where the skin is so tough, that the tiger can make but little impression upon it, and capable of so much motion, that the elephant shakes him off, and falls upon him, or stamps him to death ; nor does it quit the carcass till it has reduced the whole to a soft mass. Other animals, even the heaviest, are carried off to the woods with the greatest ease; and when he is thus enraged, he cares but little for musket-shot, if they do not hit him in a vital part. In his ordinary haunts, and when he is neither hungry nor exasperated, the tiger is, like all wild animals, afraid of fire, and in such cases a lantern is sufficient protection for those who have occasion to be in the woods at night; but when hungry or excited, fire does not deter him from making his attacks. Sharp shrill sounds annoy the tiger a good deal; and in some places where they are abundant, the people contrive to keep them at a distance by blowing a sort of horn which has an acute and piercing sound. But, formidable as the tiger is in these islands, he cannot be considered so absolute a monarch as he is in the jungles of the Sunderbunds. In these last, there is no animal to attack the tiger, save the gavial, and he is only in the water or on its margin; but in the islands, the great python, *ular-sawa* of the Javese, usually called a boa constrictor, though it is not a boa, except in manners, which are very much alike in all crushing serpents, occasionally makes prize of the tiger, and even lies in wait for him, and, strongly as he is built, and little as he cares for common wounds, the folds of this powerful serpent very speedily break his bones.

From his greater activity and daring, or rather, perhaps, from his frequenting more fertile places, the tiger carries off human beings much more frequently than the lion; but there does not appear to be much truth in the common saying, that he gives human flesh the preference. Beasts of prey, from the nature of their organs of taste, cannot be very dainty in their choice; and the probability is, that of prey equally within his power, the tiger takes that which is the largest. There is not more truth in the allegation of the older naturalists, that the whiskers of the tiger are poisonous. The breath of the animal is offensive, and both the bite and the tear occasion ugly and festering wounds, but that is the case with the whole genus. As was remarked of the lion, the saliva of the tiger may not be a very wholesome application to a wound; but there is no reason to suppose that any of the genus is furnished with a direct poison, as they are sufficiently armed without it, and nature, though she always does enough, never does too much.

The tiger has many more points of resemblance to the domestic cat, both in form and in manners, than the lion has; and in the few instances which we have of tame tigers, they are represented as playful animals. They are not, of course, very safe play-fellows, as if they are irritated, they become quite unmanageable; but still there have been instances in India, of full grown tigers being led about in chains, though, as is usually done with bears so led, they have been kept muzzled. The muzzling is, in the case of both animals, more an apparent means of safety than a real one, as the most formidable weapons of both are the paws; and these led tigers have, upon occasion, been unmuzzled, in order that they might show how a tiger deals with his prey, which cannot be so well or so safely observed in wild nature.

Now, nearly the same action may be seen by any one, who has the opportunity of seeing a wild cat kill a hare or a rabbit, and part of it is displayed by the domestic cat when in play. If you tumble the cat on her back, and tease her to an affected biting at your hand, she will embrace the lower part of your arm with her paws, and keep working away with the claws of the hind feet on the upper part, as if she were attempting to tear that part in length, and the wild cat, when she has sprung upon a hare or rabbit, and beat it down, seizes it by the throat with her teeth, and round the shoulders with her paws. Then she turns on her back, and by the action of the claws of her hind feet tears open the stomach. Even bears have a similar habit, and often tear open before they bite; the hugging and tearing jointly being with them the means of putting animals to death. When the led tiger was unmuzzled, and a sheep fastened to a stake by a rope offered to it as prey, it advanced crawling and cat-wise, till within the proper distance. Then it sprung, beat the animal to the ground, seized it by the throat, clasped it around the shoulders, and, turning on its back, tore open the abdomen with the claws of the hind feet.

It is probable that this mode of preparing for the feast is common to all the genus *Felis*, at least when their prey is of any considerable size; and, indeed, it is not easy to see how they could, in any other way, rip open the belly of an animal, without completely mangling the carcase; and it is well known to be the habit of beasts of prey to open their victims and devour the viscera before they proceed to eat, and, in the case of the weighter victims, before they carry off the body. There are some of the other carnivorous genera which first break open the skull and eat the brains of their prey, but that does not appear to be done by any of the *Felinæ*. They certainly do open the abdomen, and probably the chest, of their prey; and if they do not effect this by means of their claws, it is not easy to see in what manner they can accomplish it. We have an analogous case in animals of another class;—birds of prey, or, at all events, the golden eagle. When a rabbit or cat is thrown into the cage of that powerful bird, if the cage is large enough for allowing the bird to display even her habit at close quarters, the animal is, with the rapidity of lightning, struck down by the pounce, and the eagle is instantly seen over it with one foot clutching the throat, and the other the lower part of the abdomen. It is held in this fashion with the wings of the eagle shivering, as they generally are when she kills; and when the victim ceases to throb, which is very speedily, the Eagle, with one sweep of her beak, and in all probability with that trenchant hook on the tip of the upper mandible which projects over the under one, which other than this appears not to have much use, rips open the integuments of the belly as neatly as if it were done by the knife of a butcher. The claw of the carnivorous mammalia (at least of the Felinæ) appears to be used in the same manner, and thus they get at the viscera without mangling the carcase, which they could not possibly do by means of the teeth only.

It is very generally stated, in the books which profess to give accounts of this genus of animals, and particularly in descriptions of the tiger, that the first thing which they do is to gorge themselves by drinking the blood of the animal from the vessels, and that it is for this purpose that they plunge their heads into the cavity of the body. Now, it would be a very good rule in natural history, and one would think far from a harsh or unreasonable one, to make it binding on every one who asserts that an animal does any thing, to show that it is capable of doing that thing. How it does it would be desirable; but the other and simpler matter should be indispensable.

Well, upon this principle, we would bid any one look at the mouth of any of the *Felinæ*, after they have ceased to suck their mothers, and have got their teeth, and say what sort of sucking apparatus he thinks it would make. Then we would bid him look at the manner in which a cat laps milk, and consider whether she could extract blood from the vessels of an animal. But all the genus lap when they drink; and they lap not with the tongue bent upwards at the tip and edges till it forms a sort of scoop or spoon, as is the case with the dog, they lap with the tongue bent downward at the tip, and thus they lap slowly; and the plunging of the head into the body of the animal is not done so much in order to drink the blood, as to eat the viscera.

At the same time, we do not mean to deny that all, or that any of the animals of this genus do not lap blood as well as tear and eat flesh; only their organisation is expressly formed for the one operation and not for the other; and though there is a good deal of range in every organisation, we must either allow the purpose for which it appears to be especially adapted to predominate, or there is an end of all rational knowledge of animals. We are aware that many of the *authorities* describe some of the *Felinæ* as sucking the blood of their victims before they tear the flesh; but there was a time when the *authorities* generally—and some of the *ancient* authorities still adhere to the belief—accused tom cats of "sucking the breath" of infants while asleep. Animals which suck blood always make a punctured wound, as is done by the weasel tribe, and not a lacerated one, such as is always made by the cats.

We have extended our observations on these two, the most powerful and famed species of the genus, to some length, both on account of their interest and in order to bring into one description, and thereby shorten the general account of, animals which have so many corresponding characters as the whole race of the cats, great and small, possess; and having done so, we shall be enabled to dismiss the others very briefly.

Tigers are not only subject to considerable variety in size and in the markings and tints of the colours, but there are sometimes albinos met with, which have been considered different varieties, and described

under the name of WHITE TIGERS. We give a figure of one, from which it will be seen that these albinos are feebler and less handsome than the animals which have the usual colour.

Animals of this colour are not, we believe, met with anywhere, as a variety, in pairs and producing broods of their own colour; and there is a reddish tinge in the eyes of the few solitary individuals that are met with, which tends to establish the fact that they are not a separate race, but are merely defective in the colouring matter. They have transverse bands, the same as the others, only these bands appear to consist more in the different texture of the hair than in any real difference in the colour. The hair which answers to the yellow ground has the silvery gloss and semitransparent appearance of the hair of albinos of other races; but that which marks the stripes is chalky and without lustre, so that in some lights it appears whiter than the rest of the skin, in others it appears darker, and in others still the whole colour seems to be uniform.

THE CLOUDED TIGER (*Felis macrocelis*). There is little doubt of this one being a distinct species, and according to the best accounts we have of it, it seems to be a tiger-cat rather than a tiger. The following figure will afford some idea both of its form and its

markings. It is a native of the eastern Archipelago, and perhaps also of some of the south-eastern parts of continental Asia. The ground colour of its skin is white, pure and bright on the belly, but much duller on the back, where there are stripes of rich velvet black, and the intermediate places have a greyish appearance from the mixture of black hairs and whitish ones. The markings on the sides are ill-defined blotches of a variety of shapes. The body is much more clumsy than that of the tiger, the legs are shorter and apparently thicker, but the apparent thickness is in fact owing to the thicker fur with which they are covered. The tail is longer, thicker, and much more furry, having no inconsiderable resemblance to that of some of the common cats. The eyes are not so large in proportion as those of the tiger; they are more inclining to grey in the irides; and though the animal is rather fierce for its size, they have not the same glare as tiger's eyes.

According to the descriptions, this is a comparatively small animal, not exceeding in size the largest specimen of the wild cat found in this country; and from their diminutive stature, and consequently inferior strength, they never, in their natural economy, attack man, or any other of the larger animals. It is to be borne in mind that animals of this genus always hunt singly, and that, therefore, they never can master any animal which is above the strength and arts of the individual. The genus *Canis*, on the other hand, generally make their attacks in packs or parties, even when they are in a state of nature; and thus they can vanquish much more powerful prey, as compared with the strength of the individual, than the genus under consideration. The present animal is not merely a woodland species, but it is an inhabitant of trees, lying there in wait for its prey so habitually, that the substantive part of its name, in the language of Sumatra, is *Dahau*, which means the fork of a tree. Its usual prey consists of birds and the smaller species of deer, some of which, in that country, are not larger than rabbits, if so large. It has, indeed, all the characters of that division of the genus which, from their resemblance to the domestic variety, are more peculiarly called cats. From all the accounts which we have, it appears that this animal could be domesticated with the greatest ease; and that if fed, it is good tempered and playful, and courts fondling with as much solicitude as a pet cat; but its proneness to climbing and bird catching are so strong, that there is no keeping it out of the woods. This fondness for trees and birds is no argument against a considerable similarity of disposition with the common domestic cat; for in all countries, cats are very partial to climbing and bird catching; and, in British Guiana, where the settlements are near the woods. and the woods not only swarming with birds, but have the stems of the different trees so festooned and interlaced with twining and climbing plants, that cats can mount to the very tops with as much facility as sailors mount the shrouds of vessels, the colonists are obliged to crop the ears of their cats close to the head, in order to prevent them from going to the woods.

The extreme sensibility of the interior of the ear renders any substance very annoying to them in that part, and more especially moisture. Cats thus cropt, cannot therefore go into the open air at all during the rains; and even in the dry season they cannot pursue their feathered prey in the woods at night, which is their favourite hunting time, because even then the leaves are generally covered with heavy dew, which the progress of the cat causes them to twitch into the exposed openings of the ears; and thus the cat is obliged to stay at home and pursue her mouse and rat catching, which are no sinecures at a sugar work.

The Leopard (*Felis leopardus*). The name leopard is a fabulous one in its original application, and it has occasioned no small embarrassment in the history of all the larger spotted cats of the eastern continent; nor is the difficulty yet over, for though a tolerably clear distinction is supposed to be drawn between the leopard and those other species to which it has the nearest resemblance, and which, having indiscriminately been called leopards and panthers in many instances, the distinction is more of a geographical nature than of any other. The name is composed of the two words, *leo* (lion) and *pardus* (panther), and the fable was, that the leopard was a mule or hybrid between these two species, partaking of course of the fabled generosity of the one and the savage disposition of the other. This of course was purely imaginary, and even ridiculous, as being an attempt to form distinctions of animals upon mental qualities, qualities which, in the very nature of things, animals do not and cannot possess. The exhibitors of animals, who have generally made matters worse, by investing every beast in the show with all the marvellous qualities which they could hear of or invent, and representing it as coming from the most terrible spot upon earth, and perpetrating the most sanguinary deeds,—these have increased the confusion, and popular describers have done little to diminish it. So that the true distinction between the leopard and the panther remains as much a mystery as ever; and as the only difference between them is in size and marking, and perhaps in that more active and playful but milder disposition, which seems to be connected with smallness of size in this genus of animals, it is possible that the animals may be only climatal varieties of the same original species.

The circumstances of development in size, and sullenness and ferocity of disposition, always going hand in hand in animals of the cat tribe, is a very important point, though it is one which has not much, if at all, attracted the attention of naturalists. It strongly points out the value of a doctrine which is yet but in its infancy, and which the ignorant and the prejudiced are up in arms against, in the same way in which they have been in arms against every scientific discovery so long as that discovery was new, and those bigots had the majority of mankind on their side. The doctrine to which we allude is that of a perfect type in the different natural families of animals, to which all the individuals of the family have a tendency to approximate, but which counteracting circumstances never suffer them exactly to reach. They however come nearer to the type in proportion as the circumstances in which they are placed are more favourable to the typical development, and they also stop farther short of it in proportion as the circumstances in which they are placed are less favourable. This doctrine has been, by the persons above alluded to, stigmatised as having a tendency towards materialism, and even to a denial of the existence of God; and they who have made those allegations have, like small curs which are unable to fight, exhibited their nature by snarling.

Now, we have only to bear in mind how powerfully these physical discoveries, of which the illustrious Galileo may be said to have been the founder, have conduced both to the natural proof of the existence of the Creator, and to those sublime and striking views of his power and wisdom, as displayed in creation, and bear in mind that Galileo was constrained to abjure the truth for a time, in order to escape martyrdom at the hands of an ignorant and bigotted church, as one who was subverting religion, and we can learn how to estimate those small calumnies of the ignorant of modern times.

It is true that this doctrine of types is one which calls for the very nicest investigation, and one in which conjecture cannot advance a single step, and in this it agrees exactly with the physical doctrine above alluded to. It was because that doctrine demanded of men that they should advance no opinion for which they could not show cause, that physical philosophy, in all its departments, has become matter of certainty and demonstration; and until we can carry a similar principle into the philosophy of living nature, we can never hope to find in that any thing better than a conflict of opinions fiercely opposed to each other, and all substantially wrong; just as we find in the physical systems of the ancients, and before mankind learned to form their opinions according to nature, instead of attempting to form nature according to their opinions.

This is not the place to go into any extensive investigation either of the nature or the usefulness of the system of types, and the subject is yet too much in its infancy for being made very instructive in a popular point of view; but it is necessary that even those who take the most casual and cursory view of any one living production of nature in its natural state, should know that there are specific principles in nature, well grounded in reason and philosophy, according to which the structures and the functions of animals may be studied as parts of one general and beautiful system, and not as detached individuals, which have nothing to tell but what is apparent to the senses of the most ignorant and most unreflecting observer. The latter is so contrary to what we meet with upon every other subject, that it cannot possibly be true; for it would be the most glaring inconsistency if there were not in that subject, which is calculated, above all others, to draw the attention of mankind, the same reward to that attention as there is in subjects of a humbler, and in many respects less useful character. Nor can we doubt that very much of the uncertainty, contradiction, and absurdity, which is to be met with in very many of the descriptions of natural objects, is owing to the want of established typical characters which shall form the foundation of a system at once natural, philosophical, and of easy application.

We feel the want of such a system every where throughout living nature, but no where more forcibly than in the genus *Felis*, and especially in those species or varieties of it which have led to these remarks. This is therefore the proper place to hint at the general nature of what is wanted; and we do this the more readily that, being a matter acquireable by common observation, and not by the help of any technical science, it strictly belongs to the popular view of natural history, in the best sense of the term, and may be promoted by every one who will examine those productions of nature which come within the sphere of his own observation.

It is not easy to say to what number of animals one type should in every instance be extended. The action of the animals—the part which they appear perfected to perform in nature—is unquestionably the foundation; and we must regard the whole system of animated nature as being, as every thing in nature is, sustained by the balance of certain actions and reactions. Thus, for instance, the foundation, or, if you will, the design of the genus *Felis*, is to keep down the numbers of other animals,—of other mammalia in the cases of the larger species,—so that those animals may not multiply to excess, and derange the system. The genus *Felis* is, in this respect, the ultimate genus, as it were, for the more powerful ones are not subduable, so as to have their numbers restrained, by any other race of animals in wild nature, whatever they may be by man. But we are not on this account to suppose that they are set in lawless dominion over the rest of the animated tribes; for even man, if he is to profit by the cultivation of nature, must profit not by breaking the laws of nature, but by obeying them; and in like manner we may be sure that though the more powerful species of the feline race are absolved from animal control, they are no more out of the government of nature, that is, of the Author of nature, than the weakest animal of which the least powerful of them makes prey.

Thus, we are to consider that the typical law in the animal, that is, in all the varieties or species which observation can fairly bring within the type, tends to the evolution of a certain organic structure; and that the tendency of the reacting circumstances is to make the individual stop short of its type, sooner or later, according to the strength of those circumstances. Thus we have all the feline race harmless and playful, and without their more formidable weapons—their canine teeth and retractile claws—when they are in a young state. Farther, when they are in that state, we have them all with markings of colours; and it is not a little remarkable, that different as the lion and the tiger are when they grow to maturity, the cubs, when very young, might very readily be taken for each other. We find too that the lion in Asia, in which the characteristics of the lion, the muscular appearance, and the thick shaggy mane, and also the stature, are not so much developed as they are in Africa, is a much less formidable animal than in the latter country. When we take the two animals which are considered as the leopard and the panther, and consider them in similar localities, we find a similar difference of development, although they are still as like each other in general appearance, as the lion in Asia and the lion in Africa; and thence we are, perhaps, warranted in concluding that the two are nothing but climatal varieties of one original species of animal, for whose typical development the climate of Asia is not so favourable as that of Africa.

We have a corroboration of this in the case of two other animals, the one an Asiatic, and the other an African. These are what are usually called the hunting leopards, of which the Asiatic is a smaller and much more docile animal than the African; and when we compare these two with the lion as found in the two continents, we discover an analogous change in the lion, and in these hunting leopards. The most striking difference in the appearance of the Asiatic lion is the paucity of his mane, as compared with the formidable bush which surrounds the neck, shoulders, and breast of him of Africa; and it is worthy of remark, as establishing the analogy, that the hunting leopard of Africa has a mane, though of course a small one in comparison with the mane of the lion, while the hunting leopard of India has none. These remarks are of course not conclusive, because nothing in natural history can be conclusive which does not rest upon observation at every step; but still they point out the way to a proper conclusion in a part of the subject which is at present involved in the obscurity of ignorance, and consequent uncertainty.

The usual distinctions of these animals have been the general colours of the skin and the markings; but these are not to be depended on; for though we describe or figure a specimen ever so accurately, it is not *the* leopard, or *the* panther, in the general sense, but merely *a* leopard, or *a* panther. The ground colour is generally of some yellowish shade, but that varies much in depth; in some it is pale straw colour, or even dirty white; in others it inclines to black; and there are all the shades intermediate between these: the spots are in general black, well defined, and regularly distributed; but they vary much in number and intensity, and often run into each other. Thus there can be no distinction made of the animals which can be entitled to the name of scientific ; and perhaps two may be found, one geographically a leopard, and the other a panther, which more nearly resemble each other than the other two do which come from the same part of the globe, and are geographically called by the same name. There is, however, nothing to guide us but the geographical distinction ; and so, in the present state of our knowledge, we have no alternative.

We may, however, mention the probability that the leopard of the ancients was not the leopard of modern times ; for that animal is obtained chiefly or exclusively from the Eastern Archipelago, with which the ancients had little or no intercourse, *Taprobane*, or Ceylon, being the south-eastern limit of even their conjectural geography ; and Ophir, being in Africa, where gold is still found for exportation, and not in India, where there are not, and never were, any mines of that metal.

The ancient name leads us at once and clearly to the leopard of the ancients. It was the maned hunting leopard (*Felis jubata*) of the systems, which has the spots of the panther, and, rudimentally at least, the mane of the lion ; and it is still to be found in those countries with which the ancients were acquainted, as are also the lion and the panther, or pard, between which it was supposed to be a hybrid ; and though the fact of its originally being so is purely hypothetical, it is not impossible.

A figure of a Leopard is given in the plate, "Cats," from which the character and markings will be more readily understood than from verbal description. The spots are generally pretty uniform, rather small and close, and the skin is beautiful. The animal is remarkably lithe and flexible in all its motions, and as it is considerably less than either the lion or the tiger, it is much more feeble and more mild in its expression ; but, as it lives upon smaller prey, it is more frequently on the hunt, and perhaps kills a greater number of animals than its more powerful congeners. It is said to be found only, or chiefly, in the larger islands of the Oriental Archipelago, and probably in the Eastern Peninsula. It is a very symmetrical animal, and as its expression partakes as much of wildness as of fierceness, it is among the most handsome in the whole genus. It is described as being subject to very considerable variations, both in the ground colour and in the spots, being sometimes bright yellow with the spots well defined, and at other times nearly black. The larger spots on the flanks and sides are often slightly ocellated, or have the middle paler, but they never have so much of that character, neither are they so large as the spots on the jaguar of South America, which has sometimes been shown and even described both as a leopard and as a panther.

The Panther (*Felis Pardalis.*) From what has been already said, it would be occupying space to very little purpose to enter into any detailed account of this animal as a species.

It is rather larger in size, and more ferocious in manner, than the leopard of the Eastern Isles; but, like that, it is subject to very considerable varieties of colour. It is found in central and northern Africa, and also in the south-west of Asia.

The spots upon the panther are described as being larger than those upon the leopard, and as being more regularly arranged in lines ; and if this be the case, it would lead us to infer, that in proportion as the animals of this genus approach nearer to that great strength, which must be considered as the perfection of the type, their colours have a greater tendency to be uniform. The young lion has rudimental markings of the stripes of the tiger; the panther has the spots in rows, as if they were interrupted stripes, only they are longitudinal ; and the leopard of the east has them alternating, so that they do not range in rows either way, and they are much smaller and more numerous.

The changes of colour which we trace in these animals, as modified by differences of climate, and of character thereby produced in their several localities, agree perfectly well with what we may observe in those animals which have been longest under a state of domestication by man, and which we may therefore consider as being most diverted from their natural type by artificial treatment. In them, as in the others, the most perceptible external deviation from the uniformity of nature, is the departure from the original colour ; and where wild animals are placed in climates so different from each other as the Oriental Archipelago and Northern Africa, we may naturally look for considerable differences of colour among them.

Both the leopard and the panther have the pupil of the eye contracting to a circle, as in the lion, and not to an ovular one, as in the tiger. This points them out as being more inhabitants of dry, if not open places, than of the damp and close jungles. They are both long animals in proportion to their height. The length of the full-grown panther is about three feet and a half, of which the head occupies about eight inches. The tail is about two feet and a half in length. The height of the shoulder is about one foot ten. It is only particular specimens, however, which reach these dimensions. The spots on the body of the panther are not circular, or ocellated, but formed into a sort of cinquefoils, as if five spots ran into each other ; while those upon the leopard, when they appear to be confluent, have more a quatrefoil appearance, and are usually less or more pale in the centre. The upper part of the tail in the panther is black, annulated with white ; the under parts of the body, and the insides of the thighs are white, with black markings. Among furriers, by whom the skin is much valued, the panther is sometimes called the African tiger. It is probable that, like the lion, this animal was much more generally distributed in ancient times than it is now, and was found in all the west of Asia, as far to the north as the mountains of Armenia, and their continuation eastward ; and that it even reached to the confines of those places which are now inhabited by the leopard of the moderns, if indeed the two are not the same identical species, a portion of which is left at each end of its former locality, while it has become extinct, or so much rarer, as to be but seldom seen in the intermediate part.

If we could implicitly depend upon the accounts which we have of the relative abundance of these animals at different periods of history, which, from what has taken place in modern times, cannot, we fear, be the case, we should be in possession of a most important element in the progressive natural history of the globe. Thus much at least we can infer, and it is highly important that, if man for a long succession of years so cultivates the earth as to change it very much from what it was in a state of nature, and then abandons it, owing to any cause, it does not return to the natural exuberance of its fertility, but passes into the condition of a desert, from which the art of man cannot again fully reclaim it. We have abundant evidence of this in those countries which were the first habitats of civilised man, which have now become too unproductive even for the panther. There is a beautiful and valuable moral in this, but we must leave both the inference and the application of that to the reader.

THE HUNTING LEOPARD (*Felis jubata*). This animal, which, though the point is one of no very great importance, we must consider as most probably the leopard of the ancients, is much lighter in its make, more swift in running, and much more docile in its manners, than any of the species already noticed. It is found principally in Africa, though it also occurs in the south-western parts of Asia, and there may be remnants of it in the intermediate regions of that part of the world until we come to the *chetah*, which appears to supply its place in India, and which, according to the accounts, is still more lightly made and more docile.

This species is about three feet long from the muzzle to the insertion of the tail; the head is about half a foot long, the tail about two feet, and the height is also about two feet. The head is shorter, and also more slender in proportion to the size of the animal, than in almost any other of the genus. The legs and tail are also longer in proportion, and the whole body is lighter, and formed for more prolonged exertion. Even the paws differ in some respects from the more typical cats; the toes are longer, and they come to the ground with more firmness, as the last phalanx is more produced, and also better supported by the claws. The claws are crooked and sharp pointed, as in the others, and the points of them do not come exactly to the ground when the animal walks, but they are only demi-retractile, and therefore they are not so efficient tearing claws as those of many of the genus. The feet of this animal are, in fact, in some respects intermediate between those of the typical cats and the dogs; and it is worthy of remark, that there is some sort of intermediate character, both in the action of the animal and in its disposition. It does not lie in wait, and crouch, and spring so exclusively as the others, neither does it use its paws to such an extent in the capture of its prey. It cannot follow on a long chase in the same manner as the swifter of the dogs; and, therefore, it is said that the hunters, when they do employ it, carry it on a pad attached to the saddle, till they are within sight of the game; and that when the game is shown to it, it reaches it by repeated bounds, and uses the teeth more than the paws in the capture. The chetah has those habits so nearly alike that it will not be necessary to again allude to them in the notice of that animal. The ground colour of the hunting leopard is usually a bright clear yellow on the upper part; and white on the under part and the chin. The yellow is marked with small round black spots at nearly equal distances; and the white part with larger spots further apart from each other. The last half of the tail is marked with about a dozen rings, alternately of black and white, the last one, or tip of the tail, being white. It is said that this species is easily tamed, very docile in the domestic state, and not disposed to quarrel with the dogs or other domestic animals which are its usual associates. It is called the *maned* hunting leopard, because the hair on the upper part of the neck is much longer than that on any other part of the body excepting the cheeks; on which, as well as on the neck, it stands out, and has a woolly or somewhat frizzled appearance.

THE CHETAH (*Felis venatica*). This is the Indian variety of the former species; or, if a species, it differs very little from the one just described. It is a very handsome and graceful animal, as mild in its expression as the common domestic cat, and very agile and active in its motions. It is generally, though not always, paler in the colour than the former; and though there is an indication of longer hair on the cheeks and upper part of the neck than the rest of the body, it is only an

Felis venatica.

indication. The above figure will give a general notion of the appearance of this animal.

THE JAGUAR (*Felis onca*). This is the largest, most powerful, and most ferocious of the feline tribe which are natives of the American continent. It is often called the American tiger; and in manners it bears no inconsiderable resemblance to that formidable animal, and even its size and strength are not much less. In some of the accounts, however, it has been confounded with the larger spotted cats of the eastern continent, from which it is readily distinguished, both by the peculiarities of its markings, and by its form and manners, which are more to be depended on, though the markings are fully as striking. The greater number of the spots, at least upon the flanks and sides of the jaguar, are regular ocelli, or eye spots; that is, they consist of an external circle of black, with a spot of the same in the middle, and the intermediate space of the same colour as the rest of the ground on which the spots are placed. The spots upon the cats of the east have sometimes a paler portion within the black, but we believe no specimen has occurred in them with a black spot in the centre; and, though jaguars are subject to considerable variety in colour, and also in the form and intensity of the spots, we believe no specimen of them has been found entirely destitute of spots consisting of a black circumference and a black centre. The spots, more especially those on the haunches and shoulders, sometimes have the external circle broken, so that they appear, five or six in number, ranged at equal distances round a central one. Those on the ridge of the back are in general almost confluent, while along the sides they arrange in four nearly longitudinal rows. They are often, however, mixed with transverse bars of a paler colour, having some resemblance to the stripes on the tiger. The upper part of the animal is in general of a rich yellow colour, and the spots of an intense black. The under part is white, marked with regular spots and transverse bars of black. The skin of this animal is indeed one of the most beautiful of the whole race, though there is probably less uniformity in the markings than in those of any of the others. No two individuals are marked exactly in the same manner, and generally the two sides of the same individual are differently marked. Different individuals vary much in their colour, and some are found with the spots obliterated, except a small ring at the circumference, and a little dot in the centre; on the other hand, some have been found very dark coloured, approaching to black. The following figure expresses very accurately the character of this animal.

Jaguar.

From this figure, it will be seen that, but for the markings, the jaguar has a very tiger-like appearance, only it is lower on the legs, and the tail shorter and thicker. The tail is very frequently borne with the tip trailing on the ground, though, like the tails of all the genus, it is capable of very considerable motion. There are one or two varieties of the jaguar mentioned by writers on the zoology of South America, but there seems to be no difference between them, excepting in size and in colour, and, as is the case with the tiger in the East, the larger specimens are met with in the richest places. They are chiefly found in the thick forests, near the banks of the great rivers, and seldom, if ever, to the southward of Paraguay. They are solitary animals, or, at all events, they are found only in pairs; but it is not ascertained whether their pairing is constant, like that of the lion, or only temporary, as is the case with the tiger. Analogy would, however, lead us to suppose that, as they agree most with the tiger in appearance and in locality, they also agree most with it in all their habits.

As the jaguar is not quite so powerful an animal as the tiger, and not nearly so active, even in proportion to its strength, it is not in any situation so formidable to human beings during the daylight; but, after nightfal, it is a dangerous animal, whether met with in its native forests, or when, as it sometimes does, it makes an inroad upon the remote settlements. Generally speaking, a fire or a light will keep it at a distance; but when it is very hungry, or otherwise greatly excited, it is said to bid the same defiance to these as the tiger does.

Its usual time for preying is during the night, or at least when the sun is down, and it lies in wait to attack, and springs upon the back of its prey. As the largest native mammalia of that continent are but of inconsiderable size, the jaguar finds them a very easy conquest; and since the introduction of cattle and horses by Europeans, and the great multiplication especially of the former, in a wild state, the jaguar gets nobler game than peccaries, and game more obedient to his claws than armadilloes. The full-grown bulls are as formidable to him as the buffaloes are to the lion in southern Africa; but the cows and the young he readily masters; and even the horse is said to be a favourite prey with him. His method is to lie in wait, and to spring, uttering a yell which, though not very agreeable, is not so horrible as that of the tiger, alighting on the shoulders of the larger animals; then, holding on with the hind feet, he advances his fore paws, and, grasping across the nostrils with the one, and the chin with the other, closes the nose and mouth, and, straining his body together at the same time, at once suffocates the animal, and dislocates its neck. Though the march of the jaguar is not very swift, and he is unable to carry such a load, either in the teeth or across the shoulder, as the tiger, yet he can drag the carcass of a horse for a considerable distance, and even swim with it across a river.

The strength and the predatory disposition of the jaguar make him a subject of great dislike in a country where wild cattle form a considerable portion of the wealth of the inhabitants, and therefore, among the settlers in the vicinity of his haunts, the hunting of him becomes an object of advantage, as well as of glory. This is usually done by dogs—not that they can master this powerful animal, or are very fond of going in upon him to make the attempt; but he is not so staunch as the lion, and especially the tiger, for the dogs put him to flight, from which he does not rally so as to act an offensive part. He is not habitually a climber; but if there be a sloping tree within reach, he mounts into that, and is despatched by spears or musket-shot, according as he is better situated for the one or the other. Some of the native tribes, too, are expert at despatching him with their arrows, prepared with *wourali* poison, and delivered from the bow or blown from the tube. When he takes refuge in a hole of the earth, he is either worked out, or the Indians tempt him with one hand wrapped in a skin, while they spear him with the other; but this is an exploit which requires great courage and presence of mind. As is the case with the lion in southern Africa, and the tiger in most parts of India, the jaguar is now nearly exterminated from all the settled parts of South America.

The Puma (*Felis concolor*). The puma is another South American species. It is of an uniform dun yellow colour when full grown, and has, on that account, been sometimes called the American lion, though it has few or none of the characters of the lion, any farther than that both belong to the same genus, are of a uniform colour when adult, though both have stripes when they are young.

The general form and expression of the puma are shown in the annexed figure, from which it will be seen that there is much more of the common cat than of the lion, especially in the head, neck, and tail of this animal.

Notwithstanding its cat-like aspect, the puma is an animal of considerable size, being sometimes four feet from the nose to the tail, and having the tail more than two feet long. Its height at the shoulder is a

Puma.

few inches more than two feet. Its frame is not nearly so compact or so muscular as that of the jaguar; and though, in the wild state, it displays nearly the same disposition as the other large species of the genus, it is greatly inferior in strength, courage, and activity, to many which are inferior in size. It is represented, however, as being rather a voracious animal, and keeping its food with great pertinacity after that food has been once obtained.

The puma is found both in South and in North America, probably with some varieties of colour; and if we are to credit some of the anecdotes which are related of it, we should be apt to consider it as a more formidable animal in the colder latitudes than in the warmer. This is certainly contrary to the natural analogies of the genus; and some of the anecdotes are, besides, such as cannot easily be brought within the range even of possibility. It has, for instance, been gravely said, that the puma has been known to carry the body of a man that it had killed up into a tree. Now, in the first place, it has not been very satisfactorily ascertained that the puma is a climber of trees, even when it is not loaded; in the second place, if this were ascertained, it would be an argument against the killing of the man, for the tree-cats are chiefly catchers of birds, squirrels, and monkeys; and, in the third place, notwithstanding all the marvels that have been told of lions and tigers, there is no feat at all comparable with this told of either of them. We have heard a similar story of a common brown bear carrying the body of a horse along a single tree which lay across a wide and deep ravine in the Scandinavian forests, but we never supposed that the tale was meant to be believed, and the feeling with regard to this feat of the puma is much of the same kind.

The more probable accounts represent the puma as attacking only the weaker animals, and as hoarding or burying its food; and pumas, when tamed, can be made to play with substances in the same way as young cats, only they are more indolent, and their motions not so graceful. It is well ascertained that the puma is very easily tamed, and that, if it is fed, it shows not the least disposition to attack any animal, but shows considerable affection for those who are attentive to it. Its general manners are more like those of the domestic cat than perhaps any others of the genus, more so even than the wild cat of Europe, which is often, though it would seem erroneously, considered as the parent stock of the domestic. The puma watches for birds in the same manner, and with the same action of the body, as the domestic cat, and, like that animal, it purrs when caressed.

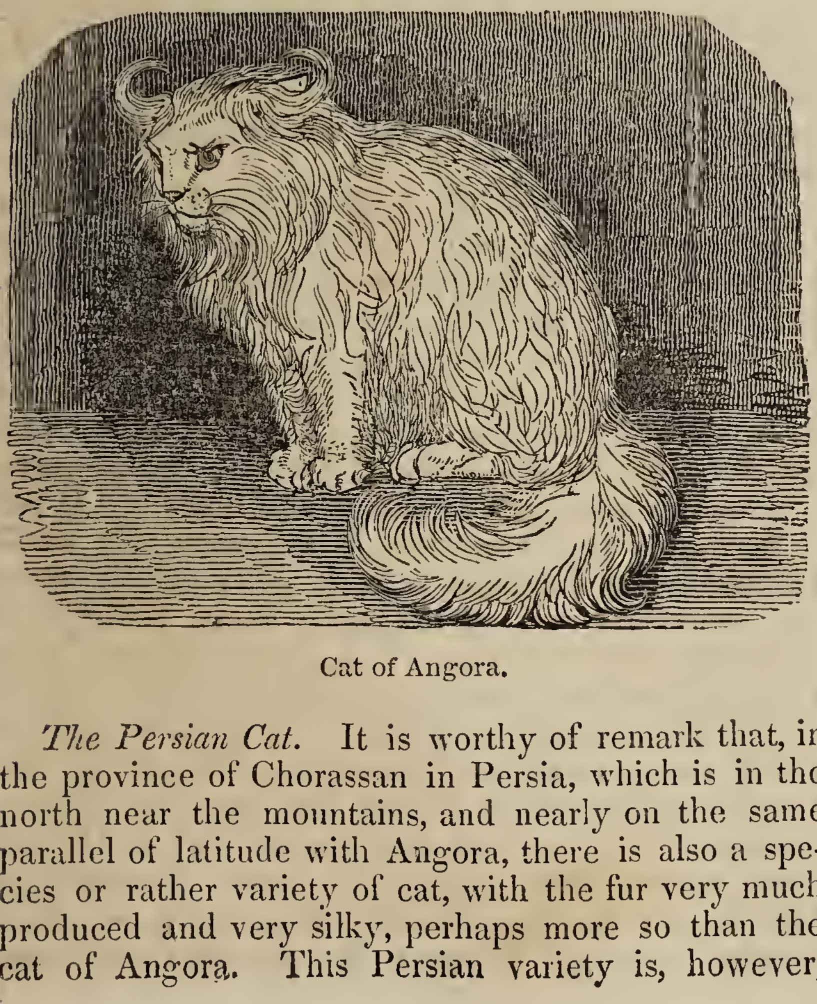
The Cat (*Felis catus*). Though we consider the specific difference between the wild cat and the domestic to be much better established than that of many others of the genus which are described as distinct species, yet we shall, for the sake of brevity, include both in a short notice. The following figure will show the character and expression of the wild cat.

Wild Cat.

This figure, which is a very faithful representation, will show that the wild cat is a much more ferocious and formidable animal than the tame one. The teeth and claws are more powerful, the ears are shorter and differently shaped, the eyes are more glaring, and the whole appearance of the animal is more ferocious. There are also some peculiarities of the internal structure which indicate an animal of more exclusively carnivorous disposition; the chief of which is that the intestines are shorter. This is a difference which could hardly be expected to arise from domestication, though that might be considered as, in part at least, occasioning the difference in the external appearance of the animals. We may perhaps add that the wild cat is a far more hardy animal, and braves the winter, exposed to the weather in even the coldest districts of Britain, in which it is in fact more at home, and attains a larger size than in warmer places. The domestic cat, on the other hand, from its fondness for basking in the sun or near the fire, indicates a more southerly origin, though it does not appear that there is any species now existing in the warm latitudes that can be considered as the parent stock. The one which comes nearest to it in manners is probably the puma; but to consider that as the parent race is out of the question. There is one consideration which should never be lost sight of when we speak of domesticated animals, and wild races as their probable parents: wild nature has undergone very great changes since man first began to domesticate animals, and as the places in which civilisation was begun are now, to a greater or less extent, exhausted and desolate, it is by no means improbable, that the parent races of those animals which have been preserved in a domestic state, have perished from wild nature as one of the effects of the change. On this point all, or nearly all, is of course hypothesis, but it is hypothesis which is necessary to a full understanding of the question.

It is altogether unnecessary to give any description of an animal so very generally known as the domestic cat; but we may mention one or two of the more remarkable varieties, observing that it is just as difficult, from their present appearance, to refer them all to one origin, as it is to believe that that origin is the wild cat now met with in this country; and we may add that though there are slight differences of disposition in these varieties, and that the most beautiful are in general also the most gentle in their dispositions, yet that there is much less difference in manners than in appearance, and that those which are best fed and most kindly treated are invariably the best natured and the most attached.

The Cat of Angora is a very beautiful variety, with silvery hair of fine silken texture, generally longest on the neck, but also long on the tail. Some are yellowish, and others olive, approaching to the colour of the lions; but they are all delicate creatures, and gentle in their dispositions. It is perhaps worthy of notice, that Buffon attributes the produced hair of this species to the fineness of the climate of Syria, whereas Angora is on the north side of the mountains of Taurus, at a considerable elevation, and exposed to the storms from the Black Sea; and therefore the variations of the climate appear to have more influence in the production or the long fur, if that be a climatal production, than the fine climate; but Buffon was no philosopher. The annexed figure represents the cat of Angora.



Cat of Angora.

The Persian Cat. It is worthy of remark that, in the province of Chorassan in Persia, which is in the north near the mountains, and nearly on the same parallel of latitude with Angora, there is also a species or rather variety of cat, with the fur very much produced and very silky, perhaps more so than the cat of Angora. This Persian variety is, however, differently coloured, being of a fine uniform grey on the upper part, with the texture of the fur as soft as silk, and the lustre as glossy; the colour fades off on the lower part of the sides, and passes into white, or nearly so, on the belly. This is probably one of the most beautiful varieties, and it is said to be exceedingly gentle in its manner.

The Chinese Cat is another variety with the fur beautifully glossed, but it is different from either of those which have been mentioned. It is variegated with black and yellow, and different from most of the race, it has the ears pendulous.

It would not be easy, at least upon rational grounds, even of analogy, to consider any of these varieties as descended from the wild cat; and, so far as we are aware, there is not, in all the wide extent of longitude over which they extend, any wild species at all resembling any of them. It is worthy of remark, however, that they all belong to a zone or latitude in which many of the other genera of mammalia that are exposed to the weather, have the hair much produced, and, whether coarser or finer in the staple, uniformly of a silky gloss; but the information which we possess respecting its natural history, either physical or animal, is neither full nor precise so far as it goes. It is enough to unsettle some of those theories which are stated with sufficient dogmatism, but not enough to substitute more rational ones in their stead.

The Tortoise-shell Cat is one of the most beautiful varieties of those which have the fur of moderate length, and without any particular silvery gloss. The colours are, very pure white, black and reddish orange; and, in this country at least, males thus marked are said to be very rare, though they are abundant in Egypt, and in some parts of the south of Europe. This variety has other qualities to recommend it besides the beauty of its colours. Tortoise-shell cats are very elegant, though delicate in their form; but they are at the same time very active, and among the most attached and grateful of the whole race. Cats generally, and it should seem those of this colour especially, are much more apt to form attachments to persons, and that not from selfish motives, than the world is disposed to give them credit for. A gentleman in the neighbourhood of London had a tortoise-shell cat which, though he never fed it, or paid much attention to it, formed an attachment for him equal to that of any dog. It knew his ring at the bell, and, at whatever time he came home, it was rubbing against his legs long before the servant came, saw him into the sitting room, and then walked off. It was a very active animal, and usually went bird-catching during the night, but when its master rose, which was generally early in the morning, the cat was always ready to receive him at the door of his room, and accompanied him in his morning walk in the garden, alternately skipping to the tops of the trees, and descending and gamboling about him. When he was in his study it used to pay him several visits in the day, always short ones, but it never retired till he had recognised it. If rubbing against his legs had not the desired effect, it would mount the writing table, nudge his shoulder, and, if that would not do, pat him on the cheek; but the moment that he had shaken it by the paw and given it a pat or two on the head, it walked off. When he was indisposed, it paid him several visits every day but never continued in the room; and although it was fond of society generally, and also of its food, it never obtruded its company during meals. Its attachment was thus quite disinterested, and no pains whatever had been taken to train it. These are but simple circumstances, yet they show the inaccuracy of the vulgar belief that "cats are attached only to places." All animals which are either necessary or desirable in a domestic state should have their due; but it has been too much the practice to elevate the character of the dog at the expense of that of the cat, though there is no question that a great deal of harmless amusement and some instruction might be derived from paying a little more attention to these, the most domestic of animals.

We would not, of course, propose any such ridiculous association and discipline of cats as that which, for a time at least, was practised by the late Lord Eldin the Scotch Judge. He had a numerous colony, to whose general accommodation he devoted a large apartment, and had them duly fed and attended, endeavouring to make them a happy as well as an orderly society. Civil wars were, however, constantly breaking out among them, to the disturbance of the neighbourhood; and at last they became so noisy, that, at a late hour one evening, he went in person to enforce the necessity of observing the king's peace, even on the part of his quadruped subjects. The Toms and Tabbies, for the whole colony were up in arms, paid not the least attention to the presence or admonition of the learned gentleman. He retired, sent for his clerk, and desired him to fetch the riot act from the library. This being obtained, the two proceeded to the territory of the conflicting cats, the clerk with the riot act, and the barrister (which Eldin then was) with a horsewhip. After proclamation duly made, the riot act was read with the necessary solemnity, and the cats warned of the consequences if they did not return to an orderly deportment before the expiry of the statutable time. That time passed without any abatement of the riot, upon which, the governor bolted the door, and bestowed on them a hearty discipline with the whip; but whether that tended to the restoration of tranquillity is not mentioned. The rest of the story, however, is strictly true.

There is some amusement in watching the conduct of a young cat with a looking glass. At first it paws at the image, but not being able to touch it, it peeps slily round the edge of the glass, as if to catch its companion on the other side. It returns disappointed, but again observing the image renews its attempt. It continues to do this for some time, and then it begins to extend its paws in a variety of directions, and to put its body in a number of attitudes, watching the corresponding motions of the image. After a while, it sits motionless, still studying the image, and retires when it is wearied. After this it is fond of taking a peep in the glass, but it does not attempt again to catch or play with the image.

The glistening of cats' eyes in the dark, or rather in dim light, is explainable upon the ordinary principles of reflection, the light being thrown back from the concave membrane, and does not, as has sometimes been said, arise from phosphoric light produced in the eyes themselves, which it is easy to see would effectually prevent the vision of the animal. It is only by the rays of light entering the eye that vision is produced, and it is easy to perceive, that if a stronger light than that which entered the eye came out of it, there could be no perception of external objects.

The high state of electricity to which the fur on the back of the cat can be excited, is a matter worthy of more consideration than it has hitherto received, because a careful examination of it would probably throw considerable light on the connexion between electricity and the heat, and, more especially, the excitability of these animals. It is probable that this property belongs to the fur of all the feline race, especially to all those which have what is called dry hair, that is, which have the fur so free from any oily substance, as to be readily injured by water. Hair of this kind is a very bad conductor of electricity, and as such, it can be made electric by friction; and it is well known that the electricity of the cat is much more easily excited in dry air than when the air is damp, and still more easily excited when the animal is placed on a stool with glass feet. Now, it will readily be understood, that this non-conducting power in the fur of the cat, must act as a barrier between what goes on internally in the animal, and, the external atmosphere,—that, if great energy is, by any means, excited, this property of the fur must prevent that energy from being dispersed in the air; consequently, that the animal must, with the same degree of original excitement, be capable of much greater exertion than if the fur were a conducting substance. We find, not only that cats are capable of being excited to more momentary efforts, than almost any animals of the same muscular strength; but that, when enraged, their passions are much more ungovernable then those of any other animals. A cat much irritated is, in fact, perfectly frantic, altogether disobedient to command, and altogether indifferent to danger. The connexion between this susceptibility of being worked up to frantic action and the non-conducting property of the fur, appears to be well worthy of investigation, as one means of establishing the identity of animal action, and the action of electricity,—or, rather, the identity of all material action, a truth, the full establishment of which would be the most important point ever gained in science; and there are many circumstances well established by experiments, performed by the most scientific and careful experimenters, that point strongly to its establishment in other cases. It cannot yet, however, be considered as legitimately within the province of popular natural history, but it is worthy of the most careful examination.

The wild cat (*F. catus ferus*) is well known in many parts of this country, and it is by no means rare on the continent of Europe and in some parts of Asia. It is much larger and stronger than the domestic cat; has the fur longer and more shaggy, the intestinal canal shorter, and the heart and stomach not quite so like those of the dog. It is a forest, at all events a coppice, animal, and disappears before the progress of population, though in agricultural countries it has a tendency to linger even in comparatively small plantations, as the small animals which collect about the neighbourhood of the corn fields, afford it a plentiful supply of food. It is, however, chiefly in the wild woods of the mountains and rocky places where it is chiefly met with in this country; and in these it occasionally attains a size which is truly formidable. Individuals of more than four feet from the nose to the tail are not uncommon, and some have been met with as much as five feet. Its principal food is the smaller mammalia, from the hare downwards, to which, however, it adds birds in great numbers; and in remote places it sometimes plunders poultry yards, but only during the night. In its native places, and especially about nightfal, it is a very bold animal, and not very apt to retire at the approach of man. On the other hand it stands in a menacing attitude, and with its eyes glaring in a very formidable manner. It does not attack; but if attacked and slightly wounded, it is apt to spring upon the assailant, and bite and scratch in a very serious manner. It may now be regarded as the most powerful of the wild mammalia of Britain.

The wild cat is never met with in bleak or exposed places, but always in brakes and copses, and in them rather than in the extensive forests of tall trees. Hunting in these is not very well adapted for them, as the birds, which would have to be the chief part of their food there, are rather too high for a wild cat's hunting: they lie in wait upon the ground, or only in the lower branches and sprays. During the greater part of the day they are in a state of repose, but they become very active about nightfal; and in places where they are abundant they keep up a very disagreeable yelling during the greater part of the night. They set up a loud cry when they are alarmed, but it is probable that the most offensive of their nocturnal music is, as is the case with the domestic cat, their love song. It is possible that, where their haunts are near houses, they may produce hybrids with the females of the domestic race; but they are said to attack the males with much determination. When hungry or irritated they are very bold in their attacks, though they always spring, and use their claws very effectively. In defence of their young, the females show the same boldness, and follow the captors of them with almost as much resolution, as the tigress herself.

Ocelot (*Felis ocelot*). This is the name of a numerous, but not very well defined, group of cats of middle size, that is to say, intermediate between the lions, tigers, and other large and formidable species already noticed, and the wild and domestic cats. There is one circumstance attending the gradations in size of these animals, which is worthy of notice: in proportion as they are smaller, the tail is larger and covered with longer fur. The group now under consideration (we call them a group only because their history is not well known) are all inhabitants of central America, but generally of more upland places than the jaguar and the puma. They are mountain cats, or rather hill cats, but still they are found in the woods, not in the open places,—the lion is perhaps more in the open wilds than any of the tribe, and even he generally crouches and lurks in thickets.

The animals now under notice may, perhaps, be considered as the American branch of an exceedingly numerous family, which are found in Africa and Southern Asia, as well as in America; but there are differences in the general appearance of those of each of the three localities. The American species, or ocelots as they are called, are the more handsome of the whole; they are "clean made" animals, light and well proportioned in all their parts; their legs are rather long, and their tails peculiarly handsome. They pace along with the same long step and majestic tread as the tiger; and though, from their comparatively thicker fur, the working of their muscles is not so well seen, yet, colour excepted, they bear no inconsiderable resemblance to tigers in miniature.

These animals are, in general, rust coloured and white in the ground of the fur, the former being chiefly on the head and along the shoulders and flanks, while the latter occupies all the under part, and a greater or smaller portion of the back. The markings consist of stripes and spots of black; the stripes are longitudinal, only, in general, inclining downwards a little towards the flanks. There are also longitudinal streaks of black on the top of the head, the cheeks behind the eyes, and the sides of the neck; but the fore-legs from the shoulder, the belly, the hind legs from the insertion of the tail, and the tail itself, are spotted with black. The stripes on the back are also interspersed with spots, and they very generally have oblong spots or darker down the margins and sometimes the middle of the stripes. Some of them have the tails annulated. There are, however, so many diversities of colour among them that a minute description, even of one, would be inconsistent with the nature of this work, and, indeed, of but little value in any work, because it is highly probable, that in animals which have their colour so much broken, no two individuals are alike. We shall mention one or two of the American ones which have been described as species or varieties.

Paraguay Ocelot. This is the *Chibi-gouazou* of D'Azzara; and though not probably confined to Paraguay, it is very plentiful there. It is two feet and a half long in the body, with the tail one foot three, and the height the same as the length of the tail; so that it is smaller than many specimens of our wild cat. It is, however, a much more handsome animal; walks more lithely, seems bolder, and has much more the air and the voice of the larger beasts of prey. It is a retired animal, living in the thick bushes, and not stirring out save during the night, at which time it is very ferocious in proportion to its size. These animals live generally in pairs. Perhaps this is the most beautifully marked of all the American tiger cats. The strokes are continuous along the sides and flanks, and finely interspersed and mottled with spots.

Mexican Ocelot. This is said to be smaller than the former, but to have even more of the tiger appearance. The colours are nearly the same, only there is a reddish ash instead of the rust colour. The stripes are shorter than in the former, and interrupted. It is found in Mexico, and on the whole of that part of America which lies to the west of the Carribbean Sea. There are said to be two varieties, one on the table land, and another on the *tierras calientes* by the sea; but as these are said to be similar varieties of that which has been described in Paraguay, it is probable that the whole form only a single species, which is broken down into many climatal varieties.

The linked Ocelot (so called because the stripes upon it are chain-like) is smaller than any of those already mentioned, and shorter on the legs. The upper part is dull yellowish, darker on the sides of the head; and the under part is white. There are irregular chain-stripes along the sides, which are continued in lines upon the legs. The tail is clouded rather than annulated. This variety or species is said to mew like a cat, but its habits are little known; and, as remarked in a former part of this article, domestic cats are apt to escape to the forests in the warmer parts of America. This fact, by the way, throws some light upon the disputed question of the original race of the domestic cat, and affords at least a strong presumption that it is not the wild cat of Europe; and when we take the structural difference into consideration, we have perhaps as strong a circumstantial proof as we can obtain in such a case. In Europe, domestic cats hunt in the woods, but they do not reside permanently there, or attempt to escape even in the mildest of our climates. If they had this disposition, they have so many opportunities of gratifying it, and they breed so freely that we should ere now have had every copse in the country completely stocked with domestic cats. There are, however, not any such; but in warmer countries they do betake themselves to the woods and remain there.

Now, in as far as analogy is evidence (and there are many parts of natural history in which if we are not satisfied with this evidence we must go without any), we find that, of the other domestic animals (mammalia at least), those of which we know the native haunts have a tendency to run wild in proportion as the country in which they are domesticated more nearly resembles that in which they are found native. Deer are natives of Britain, and we have in many parts of the country instances of them escaping from parks, and stocking the wooded hills all around. There is a remarkable instance of this in Forfarshire, where the stray deer from the extensive park of Lord Panmure have stocked many places to the annoyance of the cottagers near the plantings. The domestic dog, on the other hand, never goes into the wilds to breed there, but we believe the case is different in India. There is even a proof in birds. The common poultry, which are from the warm jungles of India, never quit their domestic habitats, or at least do so very temporarily, whereas the pheasants which are from climates comparatively temperate, and more resembling that of Britain, are more partial to the woods than to the vicinity of houses, so much so, that they must be confined in order to keep them in the latter places. There may be part of this owing to difference of habit and of power of flight in the birds, but much is unquestionably owing to climate. From this evidence, and much more might be adduced, we must conclude that the domestic cat is of a family originally inhabiting warm climates, but which is not now to be met with in a wild state in any part of the world. Perhaps there is one species of American cat about the size of those mentioned, which merits a separate notice.

The Margay. This species is chiefly found in the warmer parts of North America, though it is also met with in other places of that continent, and it is perhaps very generally distributed. The ground colour of this species is greyish-yellow on the upper part, and white on the under. It has four black stripes along the neck and shoulders, which are continued in spots along the back, the sides, and the flanks. The shoulders and thighs are spotted, but the feet, which are of a grey colour, are without any spots. The length of the body is about eighteen inches; the tail about a foot, and marked with about a dozen irregular blackish rings. It is probable that this species is known by different names in different parts of America, and also that it has been confounded with some of the others already mentioned, with which it agrees so nearly in manners that no further description is necessary. Indeed the habits of all the smaller cats of warm countries are so much alike, that when one is known all are known, with the exception of some differences of colour, and as the colours do not appear to be constant in almost any one they are matters of very minor importance.

There appears to be many varieties, if not species, of these animals in America; and it is by no means improbable that some of those which were seen and imperfectly described by the earlier writers may be now extinct. When America was first visited by Europeans the whole continent, with the exception of a portion of the table-land of Mexico, was entirely in a state of nature; and as, with the exception of the northern savannahs, no part of it was inhabited by vegetable feeding animals of any considerable size, it was peculiarly adapted for the middle sized cats. This was the case both in those places which were covered with thick forest and those which were bare. In the former the birds swarmed, and still swarm in numbers unknown in any other part of the world; and in the latter, different species of rodentia were, and in many places still are, exceedingly numerous. In order to keep down the superabundance of animal life in both those places, a number of cats was necessary; but as the prey consisted of only small animals, it was not necessary that these cats should have the same powers as the lions and tigers of the East.

The jaguar is no doubt a powerful animal, though much inferior to the great cats of the East; and the jaguar may be considered as the chief of those American species which lie in wait in thickets. The puma on the other hand is the typical species of those which inhabit the more open places, and prey upon small mammalia; and as the puma retains always a row of stripes or other markings on the sides, though in those places where it attains the largest size these are very faint, there is every probability that, in places differently favourable for its development, it differs much in colour as well as in size. The same may be said of the jaguar, and it is exceedingly probable that these two species will be found, upon more careful examination, to comprise many of those which have been described under different names—the forest varieties ranging with the jaguar, and the varieties of the open places with the puma.

Of these there seem to be some species found in that rich but partially explored country, the interior of Guiana, of one or two of which we shall quote a few notices from the very able and discriminating accounts of Hamilton Smith.

The Colocolo. "It does not appear certain," says Smith, "though it may be probable, that this is the animal Molina indicated as the colocolo, as he calls the marked spots, and not streaks, at least the word is so translated.

"This fierce animal was shot in the interior of Guiana by an officer of Lewenstein's riflemen, and by him stuffed and sent to England for his royal highness the Duke of York, but probably never reached its destination. A whimsical occurrence took place with it. The gentleman who had shot it placed it on the awning of the boat to air. As he was descending the river to Paramaribo, the boat often passed under the branches of large trees which overhung the river, and on which were the resting places of numerous monkeys, sometimes hanging to the extremest branches above the water. Although the vessel would, on other occasions, excite but little attention, no sooner was the stuffed specimen in sight than the whole community would troop off, with prodigious screams and howlings. It was of course surmised from the excessive terror of these animals, that this species of cat must be an active enemy to them.

"This animal was larger than the wild cat. The head was remarkably flat and broad; the ears large and round; the body slender; the tail just touched the ground when the animal was standing; the legs were very strong; the colour of the neck and back was whitish grey. The head, throat, shoulders, sides, belly, and inside of the limbs white. The back was marked with lengthened streaks of black, edged with tawny; and towards the shoulders and thighs with streaks of tawny. There was a black streak from the corner of the eyes to the jaws, and some bar like marks on the forehead. The outsides of the ears were dark grey, the insides pink and naked, as well as the nose. The tail was semi-annulated with black, having a black tip, and it exhibited a great peculiarity in the legs, which were all of them of a very dark grey colour up to the knees."

The Chati is another distinct American species, and the smallest of the whole. It is about eighteen inches long, the tail ten, and the height at the shoulder about eleven. The ground colour is brownish grey passing into white on the throat and belly, and the cheeks are also white. It is marked with black spots of very irregular figures, quite detached from each other, though traceable in a sort of lines along the back and upper parts of the sides. It is found in Brazil, but probably exists in several other parts of South America.

The Serval. This is the tiger cat of Africa, and an idea of its appearance and markings may be obtained from the annexed figure.

The Serval.

Africa appears to be the principal habitat of this species, though, it is probable, also found in the adjoining parts of Asia. In its general appearance and character it bears no inconsiderable resemblance to the last mentioned of the American species; and like them it is very probable that climatal varieties have been described as different species. It is the tiger-cat of the fur dealers, and brought under that name from Northern, Central, and Southern Africa, and, as the different parts of that continent differ very much in their physical characters, it might be supposed that there are corresponding differences in the same animal as inhabiting Barbary, Guinea, and the Cape The general colour is tawny, inclining to grey in some species, and yellow in others; but the insides of the legs, the lower part of the body and neck, are white. The produced hairs on the fore parts of the cheek are black, and from them double black lines extend to the throat. There are also black lines on the back of the neck, and the rest of the upper part of the body is spotted, the spots being continued as represented in the figure.

This is an animal of considerable size, though its size, like its colours, is subject to considerable variation. It is usually met with from two feet to two feet two inches in length, exclusive of the head and tail, the first of which measures four inches and a half, and the last twice as much. The height is about fifteen inches.

The serval is an exceedingly lively animal, found chiefly in the forests, in which birds and monkeys appear to be the principal part of its food; and from its size, the delicacy of its fur, and the beauty of its markings, it is much sought after by furriers. It is probable that this is the animal which has been described as the *Caracal*, or naked-eared lynx of northern Africa, and also that climatal varieties of it are the Cape cats, of some authors. It should seem that the colours of these animals vary considerably by age; and as the size also varies, not only in this, but in every species of the genus, which continue for a great part of their lives to grow in the bones, as well as to gather flesh, it becomes exceedingly difficult to ascertain whether the different sized and coloured specimens which are met with, be or be not different species. This is the grand difficulty which is met with in the systematic natural history of the genus *Felis*, and it is a difficulty of which there does not appear any means of getting the better. The wild habits of the animals, their retiring from view during the day, and their flitting before the progress of civilisation, render them puzzles to systematic describers. In their real natural history there is however no difficulty; for all the middle sized ones, with smooth ears, agree so closely in their habits, and perform parts so exactly alike, though in different quarters of the world, that there would be no great impropriety in regarding them all as one species, and including the wild cat of Europe among the rest.

As might be expected, animals of this description are very numerous in the south-east of Asia; and, as is the case in other parts of the world, their history there is a little perplexing; though the manners of all the varieties resemble each other so much that, in as far as utility is concerned, no serious inconvenience arises from the difficulty of determining the species. As is the case in the western world, some of them inhabit the banks of the rivers, and prey upon the small bank quadrupeds, and even upon fishes; but the greater number are found in the woods, with which all the richer parts of India and the oriental isles so much abound. We shall mention one or two of those which have been described as species :—

Java Cat (*Kuwuk* of the natives of that island) is of a greyish-brown colour above, with the throat, neck, and other parts, white; the ears are small, and placed at a considerable distance from the eyes; the body is small and handsomely made. This is a very active and also a very handsome animal, bearing a considerable resemblance to the domestic cat, in the general form and action of the body, but differing so much in the head, that it cannot be considered as the parent stock of that animal. The whole of the upper part is marked with distinct blackish spots, which form streaks on the head and neck, but gradually become rounder as they proceed toward the tail. The tail is annulated, though somewhat irregularly. The length varies; but the average, when full grown, is about two feet, and the length of the tail, and also the height of the animal, about nine inches. This species is entirely a forest animal, and very abundant, resembling in its habits our wild cat, as nearly as a tropical animal can be supposed to resemble one of temperate climates. It forms its den in hollow trees, where it remains inactive and silent during the day, but at night it is exceedingly active, committing extensive depredations among birds and the smaller mammalia. It seems, indeed, to be one of the most voracious feeders in the whole genus; and is not so delicate in its feeding as some of the others, as it eats carrion greedily when recent food cannot be obtained. It is a fierce animal, quite untameable, according to the accounts, and at the same time very bold and daring in its manners, invading the poultry yards of the natives with equal boldness and dexterity. Indeed, in its native woods, the perching gallinidæ form no inconsiderable portion of the prey of this animal; and they breed so fast as to afford it a very ample supply.

The Sumatra Cat. It does not appear that this species differs in any material degree from the former; only it is said that the ground colour on the upper part is yellower, the spots larger, blacker, and more irregular; and that the animal is found nearer to the water.

Diard's Java Cat. This species, if distinct species it be, was discovered in the forests of Java by the naturalist whose name it bears. It is described as being larger than the other, being about three feet long, exclusive of the tail, and standing a foot and a half high from the shoulder. It is greyish yellow on the upper part, with distinct black spots which form longitudinal rows; and on the flanks these spots are annulated, black, with grey centres. The tail is annulated, or perhaps rather clouded with grey and black. It is not so common as the species formerly mentioned.

There are some species or varieties of cats in the central mountains of Asia, to the northward of India, with whose appearance and manners we are little acquainted; and the few notices which have been given of them are so indefinite, as to render it unnecessary to refer to them here.

It must be borne in mind, that there are difficulties attending the natural history of this part of the world, which render it somewhat difficult to decide between what are really natural productions, and have remained in that state from the beginning, and what are productions once domesticated or cultivated, which have lapsed into a wild state, in the various changes and revolutions which that part of the world has undergone.

To the northward of these central mountains we may expect a change in the animals of this genus, corresponding to that which occurs in the general physical circumstances of the country. In consequence of the drought, the summer there is nearly as warm as in India, at least the more elevated and northerly parts; but the winter is very cold, colder indeed than in Europe under the same parallel of latitude. The coverings of animals undergo changes, adapting them to these extremes of temperature. It consists of two sorts of hair or fur; a close and woolly one, more or less frizzled according to the species of animal, and one consisting of longer and straighter hairs, which serve to throw off the snow, while the under fur protects the animal from the cold. There is only one well ascertained species of cat which inhabits this part of the world; and it is found in the mountains which skirt the southern boundary of Siberia, and eastward along Chinese Tartary. This species is

The Manul (*Felis manul* of Pallas). This species is in its covering, and several other of its characters, intermediate between the cats, properly so called, and the lynxes, but its tail is much longer than that of the lynx, and its ears are not pencillated, that is, they do not terminate in a pointed brush of hairs. There is one variety of the lynx, a red one, with very obscure spots, to which this animal bears no inconsiderable resemblance; but the tail of the manul is long and bushy like that of the fox, and marked with about nine rings of black. The general colour on the upper part is reddish-yellow, fading into whitish on the under part; this colour is nearly uniform and entire; but the forehead and top of the head are mottled with small black spots. The winter fur all over the body is nearly two inches in length, but it is cast as the warm weather sets in; and toward the latter end of summer, when the new fur is rather less than an inch in length; the skin is highly prized by the furriers. The muzzle is very short, and the animal is said to possess one tearing tooth fewer than the typical cats; but still it belongs to the genus *Felis*, and not to any other.

In its general habits it differs from all its congeners, being found in bleak and exposed places, generally among the rocks, where it seeks its food by chase rather than stratagem. That food consists chiefly of hares and other rodent animals, which abound very much in these wild places; but, true to the habit of the genus, it preys during the night, and most likely catches these animals when squatting on their forms. It does not climb trees or enter the forests; and, according to all the accounts which we have of it, it differs greatly from the rest of the genus. There are, however, many particulars to be ascertained before we can speak decidedly respecting either its natural history, or the natural history of the very peculiar district which it inhabits. We may, perhaps, at some future period, be able to establish this, and one or two animals of similar places, of which the indications are exceedingly vague, into a separate group or sub-genus; but at present the data which we possess are too scanty for this purpose, and we must therefore describe the manul as a cat, intermediate between the southern cats and the northern lynxes, but combining with the characters of these some at least of the habits of the fox.

LYNXES. These animals form a tolerably distinct group, of which the most remarkable characters are—the fur very long, the ears pencillated, and the tail short. They are bold and fierce animals, though without the savage character which marks the more powerful cats of warm climates.

Barbary Lynx, or caracal. This species is found in northern Africa, and south-western Asia, at least as far to the east as Persia. Its colour is uniform venous red; the ears are white within, but black on the outside, and they stand up conspicuously. It is on this account that it is called "caracal," which is the Turkish for black ear. Its length is—the head five inches, the body two feet, and the tail about six inches; and it stands about a foot and a half high at the shoulder. This is the species which borders most nearly on the manul, and the one with which that animal has sometimes been confounded; but the difference in the ears and the tail is sufficiently conspicuous to prevent any mistake with those who have seen both animals.

The Booted Lynx, or *Marsh Lynx*, is a smaller animal than the former, and its colours are not so entire. It inhabits the same regions of the world, only it frequents more humid places, and preys upon aquatic birds, indiscriminately with small mammalia. Its size is rather greater than that of the common wild cat, though that animal varies so much that it forms but an indefinite standard. Its tail is shorter than that of the caracal, but not quite so small in proportion. Its colour is yellowish-brown on the upper part, shaded deeper in some places, fading into lighter on the belly, and on the throat nearly white. The limbs and cheeks are yellowish, and so are the insides of the ears, but there are three black annuli on the tail, and the tips of the ears and hind parts of the paws are also black; from which last circumstance the name of booted lynx is given to it.

The Common Lynx. Some notion of the general appearance of this animal may be obtained from the following figure, but it is an animal which ranges over a great extent of longitude and also of latitude, and thus it is subject to great varieties of appearance.

The Common Lynx.

The common lynx was in former times very plentiful over all Europe and in the northern part of Asia, but its numbers have fallen off greatly, so that it is now entirely unknown in France, and rarely, if at all, in Germany. It is a forest animal, and is met with only in those places which are covered only with thick trees; and it appears that the cause of its becoming extinct in the more cultivated parts of Europe is the cutting down of the forests. It is still abundant in Sweden, in the forests of Russia, onward to Siberia, subject to considerable variations in size and in colour. There are considerable varieties even in the same country, and in Sweden the names of "cat lynx," "fox lynx," and "wolf lynx," are known to the country people. It does not appear, however, that there is any more reason for regarding these as different species than there is for so regarding the "hog badger" and "dog badger," of which mention is made by the country people of Britain; but the lynx, even in a single individual, has some claim to all the names bestowed on them by the Swedes. It is a cat certainly; it has at least some of the craft of the fox; and its howling at least resembles that of the wolf. It is said to be very long-lived, and subsists by hunting and pursuing its prey on the tops of the highest trees, feeding on ermines, weasels, squirrels, &c., which are unable to escape from it. The lynx watches the approach of the fallow deer, hare, and other beasts of the chace, and darts on them from the branches of trees, where it lies concealed, seizing them by the throat, and sucking their blood; after which it abandons them, and goes in quest of fresh game. Its sight is remarkably quick, and it eyes its prey at a great distance. When attacked by a dog, it lies down on its back, strikes desperately with its claws, and frequently compels its assailant to retreat. When urged by hunger, it has been known to prey on its own tribe. The female is gravid nine weeks, and brings from three to four young. As its manner of howling is similar to that of the wolf, and its skin is variegated with spots like those of a young stag, the lynx has been denominated *lupus cervarius* by some naturalists, and *loup cervier* by many of the French writers. In a state of captivity it is extremely ferocious, frequently expressing its malignity by a snarling scream, and refusing to be tamed. Its fur is held in considerable estimation on account of its softness and warmth, and it is exported in great quantities from America and the north of Europe. In general, the farther north that this article of commerce can be procured, the whiter it is, and the spots are more distinct. The skin of the male, too, is more spotted than that of the female.

It is unnecessary minutely to describe the colours of an animal which is subject to so much variety from age, season, and climate, as the lynx; but we may mention in general, that its prevailing colour is reddish brown, marked with small spots of darker brown, its ears long and pencillated, and its tail short, and black at the tip. The fur on the body is very long, especially in the winter months, and in the more northerly localities; and in these the colour in winter becomes much paler than it does in places farther to the south.

It is natural to suppose that an animal which is passing away, as the lynx appear to be doing in many parts of the eastern world, should change its characters in the individual along with the decrease of the numbers; and therefore, though we cannot perhaps give implicit confidence to the stories told by the ancients of the strength and craft of this animal, yet it is highly probable that lynxes were much more formidable, and also much more daring, when they inhabited the rich forests of central Europe, than they can be now that they are confined to the comparatively barren pastures of the extreme north. It is true that the centre of Europe was colder than than it is now; but it is also true that, with reference to wild nature, it was more productive.

We have evidence of a falling off in the character of the individuals, being an accompaniment of decrease in numbers in another animal of this genus—the lion himself. Upon turning back to the notice of that animal, it will be found that, in India, and partially also in Persia, where lions have reappeared after they were supposed to have been extinct even for centuries, they evinced very considerable deterioration of character, which clearly show that in their case there was a wasting of the race, as well as a lessening of the numbers, during the period of their decline.

Those which are now met with in India are smaller and lighter made, paler in the colour, and with their mane small and feeble as compared with the lions of Africa, where these maintain their position as lords of the wilderness. And if this has been the case with one animal, we may not only conclude that it must be the case with all other animals of the same genus, but with all animals whatever. A race of animals may be cut down in their strength, if a direct war of extermination is waged against them; but if they yield to the change of natural circumstances, they must yield gradually, and decline in strength and energy of character, generation after generation, for some time before they become extinct.

This is a most important branch of natural history—a curious law in the animal economy, from which man himself is not exempt; and any one who has an opportunity of examining, for a long period, the lists of men in any given locality, will find that it contains a curious succession of surnames, and consequently of races or families. We shall find, for instance, the predominance of some particular surname at almost whatever point of the record we may begin, and at the same time we shall find several other names less numerous.

After a time, some of these will increase in number, while others disappear from the record, and the increasing ones will grow till they become predominant, and again fall off. Of course the waxing, the waning, and the permanence, are not the same uniformly, neither are they the same even in one family. But still the progress of the law itself is exactly as has been now stated; and, were such records accurate, a philosophical examination of them would be of great value in studying the progressive history of human society.

Now, in all the rest of nature, and more especially in animated nature, we may fairly look for the same vicissitudes, and though these may take place sometimes at long periods, and sometimes at short ones, yet this is the only rational way which we have of connecting the state of the world as at present it exists with those former states, of which we have dumb evidences in the remains both of animals and of plants, and also for enabling us to grope our way to the future, in so far as that is practicable.

This is not the place for even giving an outline of what should be done on this highly interesting, but exceedingly difficult subject. We must content ourselves with throwing out the hint, and earnestly recommending it to the attention of our readers. At the same time, we may remark, that there are few animals whose progressive history is so important in this respect as the common lynx. We cannot say positively that the lynx follows the pine forests, but still, whether we look at the eastern continent or America, there appears to be more connexion between them than can be merely accidental.

Canada Lynx. This animal is much longer furred, and has fur of a much finer texture, than the common lynx, and on the sides of the head the fur is very much produced. The general colour is pale ash, yellowish on the upper part and whitish on the under, but without any spots or markings. The grey colour is produced by a mixture of the yellow basis and white tips of the fur; in the more northerly parts of Africa the colour is very pale and very entire; but farther to the southward lynxes are found with shorter fur of a reddish colour, and more or less spotted with brown; and in the mountains to the westward of the United States they are described as being different. It is possible, however, and indeed by no means unlikely, that there are local or climatal varieties of one species, or at most of two; and though their skins are obtained in great numbers by the fur-merchants, we are still without any good account about the animals themselves, and we must look to others than the hunters for better information, because those whose business it is to kill animals are very seldom good naturalists.

We must here close our notice of this most interesting genus of wild animals—a genus, the characters of which are imperfectly understood, and whose history is involved in much confusion; but there is so much to be done, and also to be undone, that we must content ourselves with the hints already given, until the animals shall be more carefully studied in their native dwellings.

CATABROSA (Beauvois). A curious aquatic perennial herb, indigenous to Britain. Linnæan class and order *Triandria Digynia.* Natural order, *Gramineæ.* The catabrosa aquatica was formerly called aira aquatica in English botany; and there is another species called viridula; but they are both small inconspicuous plants.

CATALPA (Tussac). A fine flowing ornamental tree, formerly called Bignonia catalpa. Linnæan class and order, *Decandria Digynia.* Natural order, *Bignoniaceæ.* Generic character: calyx in two parts; corolla bell-shaped, tube swollen, limb of four unequal lobes; stamens five, three of which are sterile; style bearing a double-plated stigma; capsule pod-shaped, two-valved; dissepiments opposite the valves; seeds many, their base and apex covered with membranaceous down. This tree has been in our shrubberies ever since 1726; and in old gardens, where collections of curious plants were cultivated, the trees have got to a considerable size, and are annually covered with flowers.

CATANANCHE (Linnæus). A genus of two species of ornamental herbs, one perennial, the other an annual, both natives of the south of Europe. Linnæan class and order, *Syngenesia Æqualis;* natural order, *Compositæ.* Generic character. anthodium imbricated, with broadish carious scales; receptacle bristly; pappus composed of five chaffy awns. These plants thrive well in the open borders, and are propagated by seed, or divisions of the root.

CATAPHRACTUS (Lacepede). A genus of soft-finned fishes with abdominal fins, belonging to the family of *Siluridæ* in Cuvier's arrangement. The characters are, the body almost entirely cased on the sides by four rows of scaly pieces, similar pieces on the upper part of the head, but the point of the muzzle and the lower part of the body are naked. There is only a single ray in the anterior margin of the last dorsal fin. The spine in the pectoral fins is very strong, but that in the first dorsal is short and feeble. The opening of the mouth is small, and the teeth are barely visible. The eyes are very small, and placed in the sides of the head.

They are all fresh water fishes, and found in the rivers of warm countries. Some of them have the pectoral spines smooth, though the greater part of them have them jagged or toothed. These spines, especially the jagged ones, are capable of inflicting very severe wounds; and they appear to form the natural weapons of the animals. They are bottom fishes, having the gill-openings very small; and they are very tenacious of life, and can crawl and wriggle about on the dry ground like eels.

CATARIA. The old trivial name, and now the specific name, of the *Nepeta*, or catmint of Britain.

CATESETUM (Richard). A curious family of South American epiphytes. Linnæan class and order, *Gynandria Monandria;* natural order, *Orchideæ.* Generic character: flowers ruspinate; sepals unequal, conniving, and hollow; labellum large, inflated, concave, and adhering to the column; column cylindrical, concave in front, dilated above; apex produced to a point; two filiform processes project downward from the column; pollen in two masses.

There are six species of these interesting plants already introduced into English collections, and no doubt many more will in time be found in the same quarter of the world. Their management in our hothouses is as yet but imperfectly understood; but great advances have been lately made in the culture of *Orchideæ*, and no doubt, if suitable houses are built for them, as has already been done by some spirited individuals, their culture will be as well understood as that of any other exotic plant whatever.

CATCHFLY. The English name of a numerous family of herbaceous, annual, biennial, and perennial European plants, called *Silene* by Linnæus and other botanists. Some of them are highly ornamental, many are pretty, and all of them curious. The strong-growing sorts thrive best in light rich soil, and they are all easily increased by cuttings or by seeds.

CATECHU. The specific name of a palm, called *Areca* by Linnæus, and by the English cabbage-tree. It also yields the medicine called catechu.

CATERPILLAR. A plant so called from the resemblance of its curious-twisted pods to the larva of butterflies. It is the *Scorpiurus* (scorpion's tail) of botanists, and consists of six species, all natives of the south of Europe. As objects of curiosity, the plants are raised in flower-gardens along with other hardy annuals. The flowers are nothing, but the pods are exceedingly curious.

CATERPILLAR. The common name by which the larvæ of lepidopterous insects are known. There is the greatest possible difference in the appearance of these insects in this stage of their existence, so that it is difficult to lay down any general observations upon them. They are for the most part of an elongated and cylindric form, and the body is fleshy, often entirely naked, but oftener clothed with hairs, spines, tubercles, or warts; they are composed of thirteen rings, of which the first represents the head, the second, third, fourth, the thorax, and the remainder the abdomen of the perfect moth or butterfly; moreover on each side of the body nine breathing spiracles are to be observed. The head is generally of a more scaly nature than the remainder of the body, and is furnished on each side with six minute shining tubercles which appear to be the rudimental eyes of the future insect, as well as with two short conical antennæ, and a mouth furnished with a pair of very robust jaws, two fleshy under jaws with their two palpi, and an under lip with its two palpi. The silken matter which is spun by these insects, and which in the silk worm (which is the caterpillar of *Bombyx mori*) constitutes one of the most valuable of insect productions, is elaborated in several long internal vessels, of which the extremities are narrowed and terminated in a tubular and conical tubercle, situated at the tip of the lower lip, which thus acts as a spinneret for the discharge of the silken threads. Caterpillars are also furnished with six short-jointed scaly legs attached in pairs to the second, third, and fourth segments, and representing the legs of the future insect; they moreover possess from four to ten fleshy legs armed at the extremity with a circular series of innumerable little bent hooks; the hind pair of these false legs, as they have been termed, are placed at the extremity of the body near the anus; and it is by the assistance of these fleshy legs that the insect in general retains its hold upon the substance upon which it is placed; thus we find the fore legs of the sphinx caterpillars seldom employed except in progression, the insect when at rest raising the fore part of its body into a curved position, whence the fanciful name of sphinx was given to this

Fig. 1, Caterpillar swallow-tailed moth (*Curapteryx Sambucaria*). Fig. 2, Caterpillar privet hawk-moth (*Sphinx ligustri*).

group of insects. In like manner many of the looper caterpillars when at rest erect themselves into an upright position, or at different angles with the branches, on which they are observed attaching themselves firmly by means of the hind pair of false legs alone, closely resembling in this situation small twigs, a resemblance greatly increased by the colour and warty appearance of many of these animals. These species have only ten or twelve legs including their six fore legs, and have obtained their name of loopers from the curious manner of their progression, seizing hold of the twig with the fore legs they elevate the intermediate rings of the body until it almost assumes the appearance of a ring by bringing the hind legs almost in contact with the fore ones, so as exactly to resemble the Greek letter Ω, as represented in the figure of *Abraxas grossulariata;* they then leave go with their fore legs, and extend the body in a straight line, retaining at the same time with their hind legs the hold of their advanced position, so as to enable them again to effect the same manœuvre. They are enabled to effect these motions as well as to retain their fixed and outstretched position for a great length of time, by means of the prodigious muscular power which they possess. In fact, according to Lyonnet, in the caterpillar of the goat-moth (*Cossus ligniperda*), there are more than four thousand muscles.

Thus we see that the hasty assertion contained in a work which has just been published, that the possession of a greater number of eyes than two, and of legs than six, leads us to refer an animal to some other division of animated nature than that of insects, is completely negatived, as well as the following statement, that "the propodeon* and following segments never bear limbs of any kind, whether wings or legs."—Newman's Grammar of Entomology, 1835, p. 100.

Caterpillars are, for the most part, vegetable feeders, some feeding upon leaves, often causing great destruction, as we have lately had occasion to mention under the article Bupalus; the cabbage caterpillars, and those of the brown-tail moths, may also be mentioned; others devour flowers, roots, buds, and seeds; whilst a few feed upon the ligneous particles of trees, boring, as in the case of the goat-moth, &c., through the stems, and sometimes even completely destroying them when in a young state; others, again, feed upon cloth, furs, &c., of which the caterpillar of the clothes-moth, one of our most destructive domestic enemies, is an example; whilst a few devour lard, wax, and other fatty matters, as in in the galleriæ; some species are confined to a single plant, whilst others, as the garden-tiger moth, will thrive upon many different sorts; some species, again, are found in a state of society, as is especially the case with the small ermine moths and the processionary caterpillars; these spin a common web, which serves to protect them during inclement weather. Others, again, take a similar precaution, although solitary in their habits, as is the case with many small *Tineæ*, *Psyche*, *Fumea*, and in the large exotic *Oiketicus*, all of which form portable mantles, or cases, in which the caterpillars reside, and in which they become pupæ. Many species of the minute and gilt *Tineæ* reside within the body of different leaves, feeding upon the parenchyma, and forming slender tortuous passages. Many caterpillars feed by night; the majority, however, are day insects.

These caterpillars, for the most part, shed their skins four different times previous to becoming chrysalides; they then generally spin a silken cocoon, in which they inclose themselves, and in which they undergo their transformations. Others, however, simply fasten together the neighbouring leaves, particles of earth, or of the substances upon which they have been feeding, so as to form a rougher kind of cocoon. The caterpillars of butterflies, however, as we have stated under the article Butterfly, very rarely indeed take any of these precautions.

The following extract from Mr. Peale's beautiful "Lepidoptera Americana" (of which the publication has recently been commenced in Philadelphia), will, we are sure, be read with interest, presenting as it does one of the most interesting manœuvres hitherto recorded relative to the insect race. It relates to the *Bombyx Promethea* (Linnæus), a very handsome large moth, very abundant in 1833 in the vicinity of Philadelphia, at least judging from the number of cocoons seen hanging from the branches of the sassafras (*Laurus sassafras*) and spice-wood (*L. benzoin*), and which, by an ordinary observer, would readily be mistaken for withered leaves which had withstood the blasts of winter, for such they were evidently intended by the little architect to represent whilst preparing its narrow cell. After the caterpillar has attained its full size, and lost "the voracious appetite which had hitherto been its predominant character, it begins its preparations for the great transformation it is to undergo, by selecting a perfect leaf, the upper surface of which it covers with a fine light yellowish brown silk, extending this coating with great skill and foresight over the footstalk of the leaf, and attaching it firmly to the branch, so as to secure the leaf from being separated by any accident. This preliminary operation having been accomplished, the caterpillar next draws the edges of the leaf together, thus forming a perfect external covering or mantle, in which it spins a fine strong and durable cocoon of fine silk. In this habitation our little architect passes the winter secure from birds and other enemies. As soon as the cocoon has been completed, the caterpillar again sheds its skin, and is transformed into a pupa or nymph. At first, the leaf enveloping the cocoon remains green, but soon changes to a red or brown, when it becomes brittle, and is gradually carried away by the winds and storms of winter, until, finally, nothing remains except the cocoon itself, which is firmly suspended by the silk which once covered the footstalk of the leaf." The instinct of the caterpillar in thus providing for the permanent attachment of its future

Caterpillar, leaf-cocoon, and chysali of the Prometheus moth.

habitation appears far to exceed that shown by any other caterpillars, if we except those of the pomegranate butterfly of the East Indies, of which an account was read at a meeting of the Entomological Society of London. The silk spun by the *Prometheus* moth, according to Mr. Peale, is as fine, and is produced in as great abundance, as that furnished by the *Bombyx mori*, or common silk-worm, but it is of a darker colour, and will, it is feared, always present difficulties in reeling, from the manner in which part of it is attached to the branch. We cannot conclude these observations without congratulating our readers upon that widely-extending spirit of observation into the wonders of the creation, of which Mr. Peale's work exhibits an example, trusting, at the same time, that this beautiful book will meet with that success which it so richly deserves. See also the articles Butterfly and Lepidoptera.

CATESBÆA (Gronovius). A genus of beautiful flowering shrubs, natives of the West Indies, and

* Under this name and those of podeon, metapodeon, octoon, ennaton, &c., this author has most absurdly, as far as simplifying the science is concerned, designated the abdominal segments of insects. The uselessness of such a nomenclature is equalled only by its bungling nature as contrasted with the Latin names of caput (head) and prothorax, which he has adopted, or the hybrid and incorrect names of metalæ, metapedes, &c., which he has proposed.

named in honour of Mark Catesby, Esq., author of the Natural History of Carolina. Linnæan class and order, *Tetrandria Monogynia;* natural order, *Rubiaceæ.* Generic character: calyx of four teeth or divisions, persisting; corolla tube very long, funnel-shaped, limb in four divisions; stamens, filaments inserted in the base of the corolla, long and exserted; style filiform; stigma with two teeth; berry crowned with the calyx, two-celled; seeds imbricated and scaly. These plants, from the amplitude and shape of their flowers, are called the lily-thorn, and no plant has a more splendid appearance when in flower. They are propagated by cuttings struck in sand under a glass in a hotbed.

CATHANTOCARPUS (Persoon). A genus of tropical trees, celebrated for their medicinal qualities. Linnæan class and order *Decandria Monogynia;* natural order *Leguminosæ.* Some species of this genus were formerly included in the extensive one, *Cassia*, their purgative qualities being similar. Some of them are free flowerers, and are propagated by cuttings planted in sand, in a little heat. A loamy soil is most suitable for established plants.

CATILLUS (Cuvier). A genus of molluscs, the animal of which is quite unknown; first established by Brongniart, from fossil species erroneously confounded with it.

CAT-MINT is the *Nepeta cataria* of Linnæus. It belongs to a very numerous family of perennial herbs, mostly indigenous to the south of Europe. The common cat-mint is a native of Britain, and frequently found by road sides and on waste ground.

CATOCALA (Schrank). A genus of lepidopterous insects, belonging to the family *Noctuidæ,* and comprising some of the largest and most beautiful species in the family. The body of these insects is less robust than in the majority of the group to which they belong, and the abdomen is gradually attenuated from the base, the spiral tongue is as long as the antennæ, and the latter are rather long, slender, and similar in both sexes; the wings, which are scalloped, are large and but slightly deflexed during repose, forming a broad triangle; the larvæ have sixteen legs, the two anterior abdominal ones being less perfect than the following. They do not go underground to perform their transformations, like the majority of the family, but inclose themselves in a cocoon, placed within rolled-up leaves, and covered with a fine purple bloom.

These insects exemplify, in a remarkable manner, the observations which we have in some degree noticed under the article *Calosoma;* the family *Noctuidæ* being composed, for the most part, of dingy and obscurely-coloured moths, would lead us to believe that they were formed for the dim and dusky twilight, and such is the case; but there are some insects in this family which are more gaily coloured, amongst which the gold and silver spangled moths (*Plusiæ*) are most conspicuous, and these, like their types the humming birds, are often to be seen hovering about the flowers in the hottest sunshine. In these, however, it is the upper wings which are alone ornamented, the lower ones, when at rest, being completely concealed by the upper pair, but the reverse of this takes place in the catocalæ; here too, indeed, we have even a more marked diversity between the colouring of the upper and lower wings, the former being generally grey or ashen colour, variegated with bands and markings of a darker hue, whilst the latter, which in this genus are of very large size, are nearly always of a rich crimson colour, with broad black bands. If therefore, as has been asserted, the catocalæ were twilight fliers, and "always to be observed only about six or seven in the morning, and never at any other time," the brilliant colouring of their under wings would escape notice, but such is not the case, as we have seen them repeatedly on the wing at mid-day; indeed, the author of this article has cause to remember an especial chace of one of the species amongst the willows, upon the banks of the Isis at this same period of the day. The caterpillars of these moths likewise, in their colouring, present two circumstances worthy of notice. We have seen (article CATERPILLAR) that some species closely resemble twigs, but in this genus the larvæ bear so much similarity to a stripe of brown lichen dotted with black, that they would be easily overlooked, the deception being increased by the sides of the caterpillar being flattened, fringed with short whitish hairs, and applied to the twigs; hence Lyonnet describes one of these larvæ in his recently published researches as a "grande chenille qu'on n'aperçoit pas aisément." The other circumstance which we would notice relates to the want of uniformity between the colours of the caterpillar and perfect insect; in this case the former is unsightly, whilst the latter is highly beautiful; but the reverse of this often takes place, whilst it not seldom happens that two larvæ which closely resemble each other, produce moths totally different in colouring; the habits of the caterpillar likewise are quite at variance with those of the perfect insect, for Lyonnet has observed, that none of his caterpillars fed during the day, but remained stationary in the branches from morning till evening, and it was not until after sunset that they quitted their stations to commence feeding. The same author has, with great care, represented the structure of the abdominal legs of the caterpillars, and has ascertained that there are about fifty minute doubled hooks on each foot, so that it may be said that this insect has not less than five hundred claws.

There are five or six British species, the large red under-wing moth (*Catocala nupta*) being the most common, as well as the typical species. It appears at the end of the summer; but the largest species is the Clifden nonpareil (*Catocala fraxini*) in which the under wings are of a fine pale blue, with dark bands. This is very rare, and is about four inches wide.

CAT'S-EAR is the *Hypochœris maculata* of Linnæus. There are about a dozen species belonging to the genus, all European plants. They are in the natural order *Compositæ,* and bear yellow flowers.

CAT'S-TAIL is the *Typha angustifolia* of Linnæus. There are three other species of cat's-tail, inhabitants of pools and ditches; being reed-looking plants, with their flowers and seed-vessels arranged in a cylindrical, brown head, near the top of the stems. This feature renders the typha particularly conspicuous among its aquatic intimates.

CAT'S-TAIL GRASS is the *Phleum pratense* of botanists. It belongs to the order *Gramineæ,* and consists of nine species, which are all (except two) perennials. Four of them are agricultural, and valuable as pasture and meadow grasses. They are all indigenous to Europe.

CATTLEYA (Lindley). A remarkable and beautiful genus of *epiphytes,* natives of South America. Linnæan class and order *Gynandria Monadelphia;* natural order *Orchideæ.* Generic character: flowers ruspinate; sepals spreading, nearly equal, edges undulating; labellum hollow, dilated at the point, edges waved or curled, surrounding, but not adhering to the column; column wingless, semi-cylindrical, concave in front, point obtuse, and three-toothed; pollen masses parallel. This is certainly one of the most splendid of all the *Orchideæ*, the flowers being large and richly coloured. They flower readily when properly treated; which is not by potting them in soil, but among moss in dry cocoa-nut husks, fastened to a dead stump of a tree having the bark on, set upright in the bark-bed. A moist atmosphere and a high temperature are necessary for this, and all the other South American *Orchideæ*. They are increased by dividing the root. This genus received its name in compliment to the gentleman who introduced, and was a successful cultivator of it, William Cattley, Esq.

CAUCALIS (Linnæus). A genus of annual herbs, natives of Europe, of no beauty, nor are they cultivated. Linnæan class and order *Pentandria Digynia;* natural order *Umbelliferæ*. Several of the species are found in England, and are called bur-parsley.

CAULIFLOWER. A favourite variety of the cabbage family, long cultivated in this and other countries of Europe. As the common cabbage is cultivated for its congregated head of leaves, so is the cauliflower for its large head of flowers. The flowers of almost all the Brassicæ are, on their first appearance, compactly united together, but those of the cauliflower and broccoli are much more so than any of the others. For this peculiarity of growth they are managed under prescribed rules of practice which experience has laid down.

It is not probable that the cauliflower was, when first noticed and used as a distinct culinary vegetable, so perfect as to compactness and size of head, as we now find it to be. Selecting the truest of the desired character from each succeeding crop, has been the means (by raising sub-varieties) of gaining the superior sort we now possess. And, indeed, even at this day, it requires no little share of attention to keep the best sort free from adulteration with other species of cabbage, and to prevent them running back to their original habit. The plants which produce the whitest, closest, and largest heads, are those which can only be depended on to produce their like; and, when reserved for seed, care must be taken that no inferior or different plant of the same genus be in flower at the same time near them.

This cauliflower being the most delicate of its tribe, much care is required to preserve young plants through the winter; but this is absolutely necessary, otherwise the flowers cannot be had so early for table as they are required in the spring. They, therefore, for the principal crop, require to be sown in the autumn, nursed through winter, and planted out when the spring is so far advanced as not to risk their well-doing.

The cauliflower is a biennial, that is, it requires parts of two years to arrive at full perfection. Sown in the autumn of the first year, it ripens seed in the summer of the second; and a rule must be observed as to the precise period of committing the seed to the ground; if sown too early, the flower comes forth prematurely; and if too late in the autumn, the flowers do not come into use soon enough in the following summer.

To provide against these exigencies, practical men have found that the best time for sowing the principal summer crop is any day between the *eighteenth* and *twenty-fifth* of August. It is well to make three small sowings between the first of these dates and the beginning of September, in order to have an extended season of the crop in the following year; for it is generally found that all the plants, from the same sowing, come in for use together, a circumstance to be avoided if possible. Some practitioners are of opinion, that the latest sowings in August, especially if not pricked out into nursery beds till November, are hardier, and stand the rigours of the winter better than the earlier sown and transplanted plants. There is some reason in this; because early pricked-out plants have taken root, and are in active growth when the frost sets in, and therefore more easily hurt; whereas, plants which have been pricked out into nursery beds in November, are stationary from the check of removal, and consequently less liable to suffer from frost. But whenever sown, it is the universal practice to transplant the seedlings, as soon as they have got three or four leaves, into nursery beds, either on warm sheltered borders, where they may be occasionally covered by hoops and mats in inclement weather, or into glazed frames, or under hand-glasses. In giving protection against frost, however, care must be taken not to give it unnecessarily; because the plants become so tender under coverings, that the least accidental exposure afterward kills them outright.

Protecting cauliflower plants under bell or hand-glasses, is one of the most common expedients in kitchen gardening, and is executed as follows, viz.:— A border, on the end or side of a compartment in the open garden, is prepared by having a good coat of rich dung deeply digged in. Thus prepared, it is divided into four feet wide beds, with two feet wide alleys between. Along the middle of the bed or beds a rank of hand-glasses is placed, by line, two feet apart from each other. Within the impressions made by the bottoms of the glasses, four or six of the best and healthiest plants are dibbed or let in with a trowel. Three or four of these plants are intended to perfect their heads on the spot; the supernumeraries to be transplanted to some other place in the spring. When the planting is finished, a little water may be given to each to settle the earth about their roots, especially if the weather or soil be dry, as sometimes happens in the month of October, the proper season for the performance of this work. The glasses are then put on for the winter, but, on the morning of every fine day, the south fronts of the glasses are raised on a brick-bat to admit fresh air, but shut down close again at nights.

This is the only protection and attention required by the plants throughout the winter, except perhaps taking the glasses entirely off in the middle of a mild day, stirring up the surface of the earth among the plants, and taking off dead or dying leaves, and replacing the glasses before night. Attention should also be given that no snails or slugs take up their winter quarters within the glasses, because these would assuredly injure the plants one way or other. If any enemy of the kind appear, a dusting of hot lime, or a sprinkling of lime water will kill or drive them away.

The plants, during March, will be advancing rapidly; and about the beginning of April will have filled the glasses with their leaves. When this takes place, the supernumeraries must be removed, and those that remain well earthed up, at the same time forming a kind of basin round the roots to hold water, copious supplies of which they will occasionally require if the season be dry. At this time also, the glasses are raised all round, by being set on three or four brick-bats to give head room, till about the beginning of May, when they may be taken off the plants entirely.

Cauliflower plants cultivated in this way are the first ready for table, and very often come in too much together for private use, too many hand-glasses, therefore, need not be employed; for those plants which have stood, perhaps, exposed to the open air all winter unscathed, will come into use very shortly after those in glasses. The progress of the plants depends greatly on the winter; if it has passed mildly, whether under protection or not, the plants are advanced accordingly; but, in severe and long continued frost, every exposed cauliflower plant is cut off.

In places where a high style of kitchen gardening is carried on, and where there are forcing-houses of different descriptions, another method of obtaining an early crop of this favourite vegetable is had recourse to, which is as follows:—As soon as the seedlings which are sown about the 25th of August are fit, that is, large enough to handle, they are planted in sixty-sized pots, filled with very rich compost. When potted, they are first watered, and plunged in the earth of a cold frame not too far from the glass. They must have fresh air daily, by raising the lights at the back, and kept duly watered. As soon as the roots have spread to the outside of the ball of earth, they must be shifted into forty-eight-sized pots, and, in similar compost, watered, and replunged again in the frame. In another month the plants will require thirty-two-sized pots, afterwards twenty-fours, and, ultimately, about the 1st of March, sixteens. When fairly established in these last pots, say about the 1st of April, they are taken into a peach-house or vinery, and set in pans of water along the front flue or platform of the house. Here they should have as much fresh air as possible, and should always be well supplied with water; for if, in any stage of their growth, more especially after being taken into the house, the roots get thoroughly dry, the plants immediately *button*, that is, produce flower-heads no bigger than buttons. About the middle of April the plants may be taken out of the house, and turned out into pits made to receive them, either upon a south border or in the alleys between asparagus beds. In these places they should be let in four inches below the common surface of the ground, and have the earth drawn to their stems to keep them steady. Should frosty nights occur after they are out, a few fir-boughs, stuck so as to lean over them, will save them from injury. Cauliflower plants treated in this way generally produce fine heads about the 1st of May.

An observation may be made here as applicable to the cauliflower, and all other plants whose flowers are terminal, that is, bearing them on the points of the stem or branches. Such plants are composed of a system of organs, namely, a root, stem, a certain number of leaves, flowers, and seed. If such a plant, in its early youth, receive extraordinary excitement, the flower will be brought forward prematurely, as already observed, and before the other members have acquired sufficient volume to yield a flower-head of any considerable size. This invariably happens if the seed be sown too early in August, because the natural tendency of the plant is to produce seeds before the summer is over; but by sowing later, the decreasing temperature of the season affords a longer spring-time, in which the whole system is amplified, and a larger flower produced. So also, if the early growth receive a check, either by being confined in a pot, or for want of water, or from being excited by too much heat, the stem and flower, being the central parts of the system, are suddenly protruded, and come forth diminutive and worthless. To hasten the flowering, it has been lately discovered that, if the stem of a full-grown plant be nearly cut through near the ground, and supported so as not to be entirely broken off, it will put forth its flower a week sooner than if it had not been wounded at all. This is quite a natural consequence, because the growth of the exterior organs are checked, and the remaining vigour is concentrated to expand the flower. Thus we often see plants of the same genus, when pulled up and thrown upon the bare ground, or rubbish-heap, perfect their flowers without direct assistance from the root.

The foregoing observations relate to what may be called the superior methods of cultivating cauliflowers; but they may be cultivated without the assistance of either glass or hothouses, and with no further trouble than protecting the plants from severe frost during winter. With this intention the seedlings are drawn from the seed-bed, and pricked out, as before observed, on narrow beds, on a warm dry border having a south aspect. On the approach of frost, hoops should be placed over the beds, and mats or other materials got ready to cover with. Such covering should only be kept on during the night, or in hard frosty days, which if duly attended to, the plants will be preserved, and be fit to be transplanted to their final station some time in the month of March. A piece of well-dressed ground, in an open situation, is suitable for their reception. On this the plants are dibbed in rows thirty inches apart, and in which they may stand two feet asunder. During their growth they only require deep hoeing to kill weeds, and drawing earth to their stems, to strengthen and keep them steady. Such a crop comes in for use principally in June.

The above are called the spring crop; but in order to have a succession of flowers through the summer, two sowings must be made in the spring. The first should be raised on a little heat, or under hand-glasses, close to a south wall, in the month of February, and afterwards pricked out in a cold frame, to be nursed till they are of sufficient size, and until the season serves for planting them out for good. These, with some of the underlings of the autumn sowings, will come in after the spring crop. The second spring sowing is made about the 20th of April. These are commonly called Michaelmas cauliflowers, and which begin to come in about that holiday, and last till the frost destroys them. But, as many flowers are in prime order in November, when sharp frosts may be expected, it is usual to secure all the best, by digging them up, trimming off the greater part of the outside leaves, and hanging them up by the stems in a warm shed, or stowing them upright and close together in dry earth, in a spare hotbed frame or pit, where they may be protected from frost and damp. In this way cauliflowers may be kept good till February.

There are two varieties of cauliflower in cultivation, namely, the early and the late. The first is the most delicate, the second somewhat more hardy. Both require similar treatment; and both arrive at the greatest size in the richest soil.

In saving seed, the whitish, earliest, and firmest heads, should be chosen; and when the head begins to open, a portion of the branches should be cut out, to give room and more strength to those which are left to mature seed. The curd-like appearance of a cauliflower, when brought to table, is one of its excellencies. This property is preserved by breaking down a few of the leaves over the head for a few days before it is cut for use.

CAULOPHYLLUM (Michaux). A curious tuberous-rooted perennial herb, indigenous to North America. Linnæan class and order, *Hexandria Monogynia;* natural order, *Berberideæ.* Generic character: calyx of six bracte-like sepals; petals opposite the sepals; claws of the petals scaly; stamens opposite the petals, seated below the germen; filaments short; anthers two-celled; seed-vessel inflated, closed, one-celled, three-seeded; seeds globular. This plant (there being only one species) was called *Leontice* by Linnæus.

CAVOLINA (Bruguiere). A genus of molluscs, not protected by an external covering. Second class, *Paracephalophora;* second order, *Polybranchiata;* first family, *Tetracerata,* of De Blainville's system.

CAVY (*Caviadæ*). A very interesting group of rodent or gnawing animals peculiar to South America; but which has not been a little puzzling to systematic naturalists. Indeed the zoology of South America and of Australia, both of which, though differing much from each other, are very peculiar, have suffered from the systematic knowledge of European, Asiatic, and African zoology, which has been brought to the study of them. Those parts of the world, though differing from each other, present, in this respect, singular departures from the zoology of the rest of the world; and in no part of it is the difference greater than in those animals which consume the herbage or seasonal vegetation of the ground. In Europe, and all the rest of the Eastern continent, and generally speaking also in North America, the leading grazing or vegetable feeding animals are ruminants; and the minor ones are different species of hares and rabbits. In South America and in Australia the case is totally different. In the last of these places there is no native ruminant animal; and in the first of them there are only those few members of the camel family, of which an account will be found in the article Camel, and which are confined to the mountainous districts. Some notice of the grass-eating mammalia of Australia will be found in the article Marsupiata, to which they exclusively belong; and as their numbers are limited in every other part of the world, we can conveniently treat them as a distinct order occupying a distinct locality. The grazing animals of South America are, however, much more perplexing, because in some of their characters they fall in with animals of the old continent, while in others they are altogether different. The zoology of the eastern world has, however, been made the basis of their arrangement, and therefore that arrangement contains many absurdities, and even contradictions.

How the matter shall now be remedied is a question not easily settled; but still it is a very important one in as far as rendering the knowledge of the subject at once easy and useful is concerned, for classed as animals are at present we are compelled to associate together species which have scarcely any thing in common; and thus, in the case of animals so peculiar as the rodentia of South America, we not only fail in acquiring a rational knowledge of the animals themselves, but we fail in making them what they ought to be—an index to the natural history of that part of the world of which they are natives. One can see and even excuse the fault here, much more easily than point out the remedy. The different departments of nature have been studied by different individuals, so that the student of animals has known little or nothing of plants, and the student of either has known little of those general physical circumstances upon which the characters of both animals and plants depend. Thus though there has been no want of attention to all the departments of natural history, yet each part has been studied "out of nature," entirely away from the rest as it were; and thus the grand instruction, the relations and connexions of the whole, has been lost; for instance, if one were to ask why antelopes swarm in Southern Africa, while not a single antelope is to be found either in South America or in New Holland, both of which are under exactly the same parallels of latitude, or why the herb-eating animals of New Holland should be marsupial, and those of South America not; no rational answer to either question could be gleaned from all the countless volumes which have been written on the subject of natural history. Yet there is no question that the leading animals in every case are intimately connected, and in fact the result of the general system of nature in the place where they are found; and it is just as evident that, if we could study them in conjunction with that general nature of which they are at once productions and parts, we should be enabled to give the same philosophical consistency to natural history which is found in general physical science. How we should go about doing this is another and a much more difficult matter, but the necessity for doing it, both for the sake of theoretic knowledge and of practical usefulness, is abundantly apparent.

This is a subject which thrusts itself forward most provokingly, whenever one has occasion to notice any of the productions, and more especially the living productions of South America, and it were greatly to be desired that some one, altogether ignorant of the science and systems of the eastern world, should prepare a *fauna* of that country, working out all the details upon its own structural and climatal character, and the relations which the different races bear to each other. Till this is done, we must content ourselves with simply describing the animals of this most interesting part of the world, as if they were mere strangers in Europe, museum specimens, which really had no country, and of which, farther than shape and size, we literally know almost nothing.

Every one must see, without any reflection, that the vegetable productions of the country must depend on its soil and climate jointly, because we cannot travel a day in any country without having visible demonstration of this. It is equally evident that the animals which feed on vegetables, and as we may say preserve those vegetables by destroying the superabundance, must be adapted to the general vegetation of the country. And when we advance a step farther and come to the carnivorous animals, which in their turn keep the vegetable feeders within due bounds, we may be sure that they are adapted to the race on which they feed.

Now in South America we have none of those very powerful carnivorous animals which are met with in the corresponding latitudes of the eastern world; but the smaller species are exceedingly numerous. So also, though we have no herbivorous animals in that country (with the exception above stated) at all approaching in size and strength to the ruminants of the east, yet we have races of smaller size, the fecundity of which is beyond all conception, at least all conception which could be founded upon the habits of any of our eastern animals. Our hares and rabbits breed tolerably fast, but they bear no proportion whatever to some of the group of which we are now to give a short account; for these might breed to the number of a thousand in a year from a single pair.

The animals which we shall bring together in this group have certainly a strong family resemblance; but when we come to class them according to those characters, upon which the systems are founded, we find it no easy matter to express in words in what this resemblance consists. Therefore, we have brought them together more for the purpose of saving space in the general description than for any systematic purpose. Indeed some of them have been so bandied about from genus to genus and from group to group by different naturalists, that their systematic history is more perplexing than the part which they act in nature. They are all ground animals, living chiefly upon vegetable matter, timid in their dispositions, and not, generally speaking, disposed to offer injury to any other animals, excepting perhaps one of the species which is very aquatic in its habits, and is said occasionally to eat fish.

They all bear a slight resemblance to hares, or rather to the marmot family, but in some of their characters they approach the pachydermata. They are also allied to the agoutis, but their habits are different, and their flesh is generally speaking of inferior quality. There are three genera or species, *Cavia*, *Anœma*, and *Kerodon*, of which we shall notice a few particulars.

The *Cavy* or *Capybara*. This animal has four toes on the fore feet, and three on the hinder, all armed with large hoof-like claws, and united by a membrane which, in the hind feet especially, forms very efficient webbed or swimming feet, the nail on the middle toe of which is very long. Their cutting teeth are broad, semi-cylindrical, and bevelled off so as to form cutting chisels. They have four grinders in each jaw, formed, like those of hares, of numerous upright tubes, of enamel, which are flattened anteriorly and posteriorly, and united by bone. The last grinder in the lower jaw is much larger than the rest, and the projecting portions formed on the surface by the enamel are very regular, though each of them is divided into several points. These teeth bear a very considerable resemblance to the grinders of the elephant; and though the size of the animals, and also their general structure, differ very much, yet it may be said that this animal performs, in South America, a similar part in the general economy of nature to that which the elephant performs in Asia and Africa. Of this genus of the group there is but one species, the *Capybara*, of which the following figure is a representation.

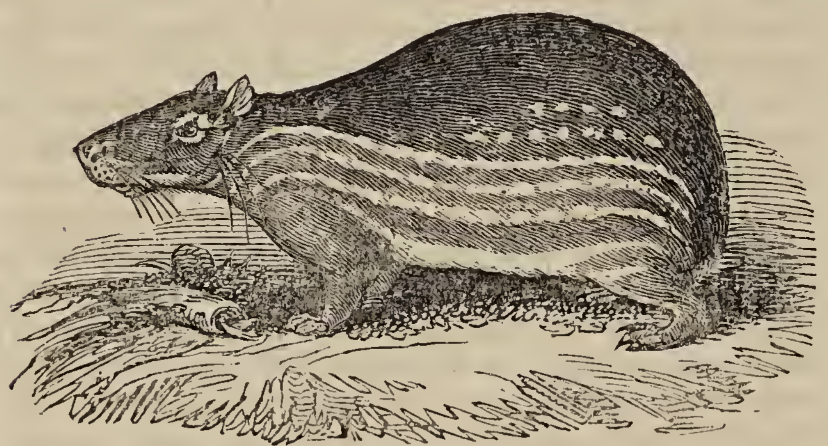
This animal, though allied in many particulars to the rest of the group, yet stands quite alone in others, the most peculiar part of its character being its aquatic habit, and the adaptation of its feet for progressive motion in the water. It is one of the largest

Capybara.

of rodent animals, measuring at least three feet from the muzzle to the hinder part; it has no tail. The general make of the body is thick, and, as one would say, pig-like; but the head is that of rodent animals generally, and like the rest of these the upper lip is furnished with mustachios. The hairs on the upper part of the head and body, and the outsides of the legs, are black at the roots and also at the points, while the intermediate part is yellow. The insides of the legs, a portion of the under part, and also round the eyes, is entirely yellow, and the mustachios are black. The mixture of these two colours gives a dinginess to the animal, and its expression at the same time is rather dull and heavy. The hair is also somewhat bristly in its texture, and sparely scattered over the body of the animal; and this increases its pig-like appearance; the ears are small and rounded. The female has twelve mammæ, which are situated partly on the breast and partly on the belly; the upper lip is divided, though not so much as in the hare, but still in the closed mouth it shows the teeth partially; the eyes are large, and of a black colour; the nose, the ears, and the naked portion of the legs, are blackish ash colour. The colour of the hair changes with age, and in very old specimens the root is black, the middle brown, and the point red. In consequence of these changes, which are in general attended with an increase of size, several varieties have sometimes been described, but there is every reason to believe that there is only one species that exists. The time of gestation is not exactly known, but it is believed to be short. The broods do not exceed four or five, but whether the female is as indifferent to them as some others of the group has not been ascertained.

The cavy is the largest of rodent animals, but its march along the ground is slow and apparently performed with difficulty. In walking it is plantigrade on the hind feet, and this gives it a crawling gait. Generally speaking, it is quiescent in its habits, its favourite position being to squat on its hams, and it may be seen in this attitude for a great part of the day. It is described as being chiefly abroad in feeding during the night, or at least in the dusk. The cavy is strictly speaking a bank animal, and inhabits the margins of all the rivers in South America, but is never seen at the distance of more than one hundred yards from the bank. These animals are social, living in small packs, and herding very peaceably. The jaguar is a great enemy to them, and probably also the alligator, when they are in the water; but that formidable reptile does not attack any animal on land; and Humboldt saw numerous flocks of cavies sitting with the greatest composure on their hams, while a large crocodile passed through the middle of them. When alarmed they take to the water, in which they swim and dive with great dexterity, and they can remain below the surface for eight or ten minutes, rising at a great distance from the place at which they disappear. It is said that they catch fish, which may be true, though it does not accord very well with analogy. Their flesh is eatable, and they are sought after with considerable avidity in some parts of America, though there is a rankness about them which is not pleasant to Europeans. From their aquatic habits the catholics, at least in some places, regard them as a sort of fish, and on that account allow them to be eaten on meagre days. These animals are tamed very readily, are gentle in confinement, and soon learn to come at a call, or follow those who are kind them; but their slow motion, their aquatic habits, and a rather offensive smell which they emit, cause them to be but little esteemed.

The *Cobaya* or *Anæma*. This is the animal which is so familiar in Europe under the name of *guinea pig*, but that name is doubly absurd, first, because the animal is not a native of Guinea, and secondly, because it does not belong to the same genus, or even the same order as the pigs. It differs from the former as being much smaller in size, in having the toes without connecting webs, in having the grinders composed of a simple lamina, with one formed on the



Cobaya.

outside of the upper jaw, and one forked on the inside of the lower jaw. This animal is much better known in a domestic than in a wild state; and indeed there is some doubt, or at least some obscurity as to the original stock. When domesticated it is so liable to diversity of colouring, that scarcely any two individuals exactly agree in this respect. Some are almost entirely white, others spotted with black and fawn colour, with yellow, tawny, &c. The body is short and thicker than that of the rabbit; the neck is not distinguishable from the head and trunk; the ears which are large, naked, and transparent, are in a great measure concealed by the hairs on the upper part of the head; the eyes are round, large, and prominent; the head and nose resemble those of the hare and rabbit; the teeth are similar to those of the rat, but they are placed obliquely outwards in the upper, and obliquely inwards in the lower jaw; and the hair is long, hard, and smooth.

As these animals are easily domesticated, and as they bear the climate of Europe very well, their manners in a captive state are easily studied. They are even said to have one domestic use, rats dislike the smell of them, and do not remain in the same house. Among the most remarkable of the characters of this animal, may be recorded its precocity and fertility; for though it attains not its full growth till eight or nine months, it is capable of propagating in five or six weeks after birth. The female goes only three weeks with young; her first litter consists of four or five, her second of five or six, and her subsequent ones of seven or eight, or even sometimes of ten or eleven. The dam gives suck only for twelve or fifteen days, and chases away her young if they remain longer by her, or if they prove refractory, she permits the male to abuse and kill them. Her parental attachment indeed seems to be much weaker than in most other species; for she will often suffer her young to be taken from her, and even devoured as soon as they are born, without betraying the least concern. As she breeds once in the two months, it has been calculated that a single couple may prove the source of one thousand individuals in the course of a year. To check this excessive fecundity, nature has provided that many of them should fall a sacrifice to cold and moisture, to the feeble and short-lived affection of their parents, to their quarrels with one another, and to their incapacity of defending themselves against cats and other beasts of prey. Their life is almost an incessant round of eating, sleeping, and reproducing their kind. Buffon asserts, that though they never drink they frequently urinate: but this is not strictly correct, for they are very fond of milk, and, in default of it, have recourse to water. They readily feed on all sorts of herbs, but prefer parsley and the tops of carrots even to bread or flour. They are also very fond of apples and other fruits. They eat precipitately like rabbits, and very often, but little at a time. Their usual cry resembles the grunting of a young pig; but they also express pleasure or pain by appropriate sounds. They are very susceptible of cold, and will press together to avoid its effects. Though naturally tame and gentle in their deportment, they are incapable of strong attachment. They affect dark and intricate retreats, and seldom venture out of concealment when danger is at hand. They are at great pains to keep themselves and one another clean, frequently licking and smoothing their own and neighbour's fur. With scarcely sufficient courage to defend themselves against the attacks of a mouse, their animosities against those of their own species are obstinate and violent, and generally originate in a desire of possessing the warmest corner, or the most agreeable food. Their mode of fighting is very singular, for one of them seizing the neck of its antagonist with its teeth, attempts to tear of the hair, while the other turns its posteriors to the aggressor, kicks up behind like a horse, and scratches his rival's flanks to the effusion of blood. The only battles which they fight are, however, battles of gallantry, or at least with one another; for they may be taken and even killed without offering any resistance, farther than very feeble attempts at escape.

Though the origin of the guinea pig, as now domesticated in Europe, is not known, there seems little doubt, that is the *apera* or wild guinea pig, which is found in the dry and rocky parts of Brazil and Paraguay. This animal is of the same size, has the same general characters, and only differs from the tame one in colour. It is reddish grey, or hare colour, on the upper parts, fading into white on the under. These animals lie concealed in holes of the rock and also in thickets; but they are met with in the dry and open places, and not in the extensive and close woods. They do not burrow; their food is wholly vegetable; and they come abroad only in twilight or during the night. There is, therefore, no reason to doubt their being the identical species which present so many varieties of colour in their domesticated state; and those colours vary so much in different individuals of the same litter, that no one of them can be considered ast he natural colour. We have a similar breaking of colour in the domestic rabbit, although the difference between that animal, in a wild and domestic state within the same country, cannot be as great as the difference between an animal wild in Brazil, and domesticated in Europe.

Sufficient attention has not been paid to the changes which domestication makes in the colours of animals; but we have at least something like evidence that the change of colour is, in some degree, in proportion to the change of treatment, including both temperature and food. But though it has been hitherto much neglected, this is a point of very great importance in the progressive history of animals. It should seem that ground animals, which seek their food in herbage, and come abroad at twilight or during the night, have all, in their natural state, less or more of an iron-grey tinge in their covering. We cannot suppose that this answers only as a means of concealment from their enemies; because, though some of them sit on exposed forms, the greater number lurk in concealment during the day, and are abroad in the faint-light. There appears to be some connexion between this shade of colour and the hardihood of the animal, and in proportion as the original colour is departed from, the constitution of the animal seems to be weakened. It is probable also that, in the case of those which are used for food, there is always a falling off in the flavour of the flesh, which accompanies this breaking down of the colour, and this may be observed by dressing a grey rabbit, and a white or a spotted one exactly in the same manner, and taking care that their natural flavour is preserved.

There is one very curious fact in the difference of habit between the tame animal and the wild one, at least if we can implicitly credit the accounts given of the wild animal. In the wild state, the female is described as producing only one at a birth, though the mammæ are the same in number as in the tame one; and we have already mentioned that the tame sometimes, though not always, produces one for each teat, that is twelve. There is reason to doubt the fact of one only being produced by the wild animal; because we know of no other case in which a female having numerous teats, and having them both on the breast and the belly, produces only a single young one. Yet the fact is expressly stated by D'Azzara, and has not been contradicted by any other observer. But from the retired habits of these animals, and the places which they frequent, and also the times at which they are abroad, it is not very easy to get an accurate account of their habits as wild. They are much less frequently seen than the burrowing animals, and therefore we are not nearly so well informed respecting them. It is probable, however, that they may be more prolific in a domesticated state than when left in free nature; and the probability rests upon an analogy which holds very generally both in the animal kingdom and the vegetable. In all cultivated plants, it is in the fruit, or the other portion by which the successional plants are produced, that cultivation produces its greatest and most beneficial effects; and the timber or whatever else constitutes the proper structure of the plant as an individual, may be said, in all cases, to be deteriorated; and though the quantity of it may be increased, the quality is lowered. It is highly probable that a similar effect is produced by cultivation upon animals; and we may suppose that this effect will be great in proportion to their natural fertility, and especially to the shortness of their gestation. This question is, however, one of as much difficulty as that to which we formerly alluded, if, indeed, it is not more difficult; but it is one upon which knowledge is highly desirable; and in the case of an animal which appears so docile, that is so obedient to artificial culture as the guinea pig, the tracing of the few hints which we have ventured to throw out on the subject of colour and fertility, would be of far greater importance than those expatiations on the helplessness of the animal which are usually found in the books on natural history.

The Moco (Kerodon) is the only other known animal of this curious group. It is rather larger than the guinea pig, and of a greyish olive colour. Its grinding teeth are also differently formed, indicating some difference in its food. Each tooth is formed into two triangular prisms, and it is on this account that M. F. Cuvier has given it the name of *Kerodon* (horned tooth). The habits of this species are but imperfectly known, only they are said to have a considerable resemblance to those of the guinea pig. It is, however, found in places which are less dry and rocky, though not near the water. Though from the character of their covering, both this and the former species can bear to be wetted without injury, neither of them are in the habit of swimming.

The systematic names which have been given to the other two genera of the group, are not quite so appropriate as this one. *Hydrochœus* (water hog) is as objectionable as the common name of guinea pig is in the case of the second one; and though *anœma* (powerless) is expressive of one character of the guinea pig, yet that is not its leading, or even its peculiar character, for there are many other animals equally powerless.

Those three animals form a very well defined group; and though rodentia are very numerous in South America, these form a distinct section, both in the structure of their teeth and in the places which they inhabit. We have the largest of them inhabiting the immediate vicinity of the waters, where the productions of nature are richest, and where the largest animals of every natural group and order are to be met with. Then we have the Moco in the intermediate localities where nature is less productive; and lastly, we have the guniea pig among the rocks, or in the dry thickets, upon the margins of the arid plains, or of those savannahs which are burnt up with drought at one season of the year and laid under water at another. When we get into places which are more open, the vegetable feeders of South America are still rodentia, and have sometimes been classed in the same group, and even in the same genus, with the animals above noticed; but a very different structure, or at least power of action, is necessary for animals which seek their food in the dry plains. They are the *agoutis*, the *pacas*, the *biscaches*, and the *chinchillas*, some of which are, however, different names for the same animals. See the articles AGOUTI and CHINCHILLA. These last mentioned animals bring us onward to the barren portions of the country which do not afford food even for rodent mammalia; and animals of this class, from the characters both of their cutting and grinding teeth, can subsist upon much harder and drier food than any of the other vegetable feeders.

Taking them altogether, we find a regular set of animals subsisting upon vegetable matter, varying in the character of the teeth, in proportion as their habitations is farther from the rivers, and varying still more in the appearance and texture of their covering. The cavy, which is always near the banks of the streams, and very often in the banks of the water, has very little hair, and the little that it has, is of a bristly character, or bearing some resemblance to that of the pig; but as we quit the waters, we come to coverings capable of affording still greater protection against extremes of temperature, till we at last come to the chinchilla, the covering of which is exceedingly close and fine, and highly prized as fur.

Of course, this succession of animals is exactly adapted to the state of nature in South America; and from this it follows, that that country was not naturally adapted for ruminating animals, and yet upon their introduction, cattle, in a wild state have multiplied in it faster than in any other part of the world. It would be desirable to know, how far the immense herds which now range the plains, have changed the vegetation, and along with that the climate and even the soil of the country. But it is certain, that pasturing with cattle has a tendency to reduce the surface to a perennial sward, and that this sward is a means, not only of preparing the ground for the plough, but of equalizing the seasons, and thereby improving the climate. Thus, without intending it, the European settlers have been the means of beginning a great revolution in the natural history of South America, to watch the progress of which, will be a most interesting subject for future naturalists. At present, however, the data are few and not well connected.

CEANOTHUS (Linnæus). A genus of prickly shrubs and trees, natives of the tropics both in India and South America. Linnæan class and order *Pentandria Monogynia*; natural order *Rhamneæ*. Generic character: calyx bell-shaped and five-cleft; petals of the corolla clawed, hollow, (rarely none); stamens opposite the petals; stigma tripartite; capsule dry, three-seeded. This is the red-wood of the West Indies; several of the species were included in the genus *Rhamnus* by the earlier botanists, but have been separated by Decandolle, Lambert, and others. They are cultivated in our stoves, and increased by cuttings struck in sand.

CEBRIONIDÆ (Leach). A family of Coleopterous insects, belonging to the section *Pentamera*, and division *Serricornes*, having for its type the genus *Cebrio* of Olivier. These insects have the body of an oval oblong form; in others, however, which from their small size and soft consistence (*Cyphonides*), seem to depart considerably from the habits of the group—it is of a rounded and convex shape. The jaws terminate in a single tooth, and the palpi are of equal thickness throughout or more slender at the tips; the thorax is transverse, broadest behind, with the lateral angles often acute. The antennæ are longer than the head and thorax, serrated or branched in many species, and never clubbed at the tip; and the legs are not contractile. These insects seem to establish an intimate connection between the skip-jack beetles (*Elateridæ*), and the soft winged, soldier and sailor beetles, as they are termed, *Telephoridæ*; thus, in the typical genera, the breast-bone is produced into a point behind, and received into a corresponding aperture in the *mesosternum*, whilst in the *Cyphonides*, the softness of the body and several other characters seem to lead the way to the latter family. Of the early history of these insects, the majority of which are strangers to this country, but little is known. Some curious circumstances have, however, been observed respecting the typical species, *Cebro gigas*, an inhabitant of Germany and France, which seems to confirm the observations which have been made respecting the influence of atmospheric changes upon the lower animals. Thus, Olivier observed, that it was generally noticed flying with great rapidity immediately after heavy storms; and M. Farines has published a memoir upon the history of the same insect, in the Transactions of the Linnæan Society of Bordeaux, from which it appears that this insect only makes its appearance during, or after, the heavy autumnal rains, at which period of the year, if the weather be fine, very few are to be observed.

The males of this species are distinguished by their long and slender antennæ, which organs, in the females, are not longer than the head, terminating in a thick mass; indeed, so different is the appearance of this sex from the males, that Latreille was induced, at first, to form it into a distinct genus. The wings, in this sex, are rudimental.

This family may be divided into two sections:—1st, the *Cebrionides* having the body oblong and of a firm consistence; the legs not fitted for leaping; the jaws strongly curved and extending beyond the lip, which is very short and notched in the middle, and the antennæ often branched.

Here are to be ranged the genera: *Physodactylus. Cebrio, Anelastes, Callirhipis, Sandalus, Rhipicera, Philodactyla* and *Atopa*, with some others proposed by Dr. Leach in a monograph upon this group of insects, published in the Zoological Journal, and by M. Laporte, in a memoir recently published in the Annals of the Entomological Society of France. The genus *Callirhipis* is distinguished by the long and beautifully branched antennæ of the males, which are, however, only eleven jointed; the same character is found in the elegant exotic genus *Rhipicera*, but here these organs are composed of from twenty to forty joints.

The genus *Atopa* (Fabricius; *Dascillus*, Latreille); comprises the only British species belonging to this first section. It is the *Chrysomela Cervina* of Linnæus, a very variable insect as respects its colour, being clothed with pubescence, which is sometimes ochraceous, and at others fuscous. It is nearly half an inch long and is not uncommon in the woods near London. The sexes of this insect have also been regarded as distinct species. Mr. Curtis observes, "The scent of several of the tawny specimens which I took off alders and brambles, was very offensive and powerful, similar to that of the house bug; whereas, the dark ones either had no scent. or smelt merely of the plant on which they were found;" adding, "Mr. Mathews, A. L. S., has informed me that whilst he was collecting Orchideæ in Kent, on the 29th of May, 1825, he found three specimens of our beetle at the roots of

Orchis ustulata, about four inches beneath the surface of the ground, which induced him to suspect that the larva might feed upon the roots of that plant. The dwarf-orchis was in flower upon the spot when I met with two or three specimens ascending Arthur's Seat."

The second section (*Cyphonides*) has the body rounded and of a soft consistence; the jaws small and not protruded; the palpi terminated in a point, and the antennæ simple or but slightly toothed. In many the hind-legs are fitted for leaping. These insects, all of which are of small size, reside upon plants in damp situations. The genera are: *Cyphon*, Fabricius; (*Elodes*, Latreille) *Scyrtes*, Latreille; *Nycteus*, Latreille; and *Eubria*, Zeigler. The two first contain species indigenous to this country.

CEBUS. The name sometimes given to a division of American monkeys (*sapajous*), which have the head round, distinct thumbs on the feet, and the tail, though prehensile, wholly covered with hair. They are very numerous, and the characters of the different species are much more difficult of discrimination from each other than those of the howling monkeys. They are very mild and gentle in their manners, and lively and playful in their motions, but their cry is shrill and wailing, which has procured them the appellation of crying monkeys.

The species are so confused, and they all so nearly resemble each other in their manners, that the general reader could find but little pleasure in the perusal of such a "chapter of doubts," as any attempt at either defining the group, or attempting to divide the number of species, would involve. We shall save much room, and also give a little more interest to the few words we shall have to say on the subject, if we bring the whole together into one general article, MONKEY, in the same manner as we did with the apes and baboons, and as we purpose to do with all other animals which can be brought into natural groups or masses, that have English names.

CECIDOMYIA (Meigen). A genus of Dipterous insects, belonging to the family *Tipulidæ* of Leach, and to the sub-family *Tipules gallicoles* of Latreille. It is perhaps impossible, throughout the countless tribes of the insect world, to select any single genus which contains so many species of minute size, which, nevertheless, are endowed with such surprising powers of destruction, and which is, at the same time, effected in such very different modes. In this point of view alone, this would be an interesting group of insects, since it has been generally conceived that identity of generic construction implied identity of habits,—but this is certainly not the case here. The antennæ and legs of these insects are beautiful microscopic objects; the former being composed, in the males, of a long series of minute balls, connected together by a slender thread and very pilose—(this structure is termed moniliform or necklace-shaped.) In the females, the joints are longer and set nearer together; the legs are long and exceedingly slender, so as to be scarcely discernible when of a pale colour, and the basal joint of the tarsi is very minute; the wings are hairy and furnished with only three longitudinal nerves, and the body is slender, and terminates, in the females, in a long and delicate tubular instrument, of which we shall presently mention the use.

To this genus belongs the Hessian fly, an inhabitant of North America, the ravages of which have spread terror through the agriculturists of various countries in communication with that continent. This insect received its name from the prevalent idea that it had been imported into Long Island, in 1776, with the straw carried over by the Hessian troops. Messrs. Kirby and Spence thus describe the devastation caused by it,—"The ravages of the animal just alluded to, were one time so universal as to threaten, wherever it appeared, the total abolition of the culture of wheat, though, by recent accounts, the injury which it now occasions is much less than at first. It commences its depredations in autumn, as soon as the plant begins to appear above ground, when it devours the leaf and stem with equal voracity until stopped by the frost. When the return of spring brings a milder temperature, the fly appears again and deposits its eggs in the heart of the main stems, which it perforates and so weakens, that when the ear begins to grow heavy and is about to go into the milky state, they break down and perish. All the crops, as far as it extended its flight, fell before this ravager. It proceeded inland at about the rate of fifteen or twenty miles annually, and by the year 1789, had reached 250 miles from its original station. Nothing intercepts them in their destructive career, neither mountains nor the broadest rivers. They were seen to cross the Delaware like a cloud. The numbers of this fly were so great, that in wheat harvest the houses swarmed with them, to the extreme annoyance of the inhabitants. They filled every plate or vessel that was in use, and five hundred were counted in a single glass tumbler exposed to them a few minutes with a little beer in it."—Vol. I. p. 172. So great indeed was the alarm caused by this insect, that the subject was taken into consideration by the Privy Council of England, and caused so great a share of attention that the proceedings fill upwards of 200 pages.

For a length of time this insect did not find a place in the system of Entomology, and Mr. Markwick caused some alarm in the public mind by the account which he gave of the ravages of *Chlorops pumilionis*, (one of the flies belonging to the family Muscidæ) when first observed in England, and which was regarded as identical with the Hessian fly. Mr. Marsham, however, by tracing out the species, proved the alarm to be unfounded. The late Mr. Say, the most celebrated of American Entomologists has, however, cleared up the question by publishing a detailed description of the real Hessian fly, under the name of *Cecidomyia destructor*, in the Journal of the Academy of Natural Sciences of Philadelphia for 1817. A notice of this memoir, with additional observations by Mr. Kirby, will be found in the Magazine of Natural History, Vol. I. The female deposits from one to eight or more eggs, on a single plant of wheat, between the sheath of the inner leaf and the stem, nearest the roots, in which situation, with its head towards the root or first joint, the young larva passes the winter eating into the stem and causing it to break.

If England, however, be free from the ravages of the Hessian fly, another species of the same genus takes its place, destroying, but in a considerably less degree, the same invaluable plant. This is a minute orange-coloured gnat, of which the proceedings are detailed at great length in several of the early volumes of the Transactions of the Linnæan Society. It is during the period of the blossoming of the wheat that this insect, the *Cecidomyia tritici* (*Tipula tritici*, Kirby) makes its appearance, and introduces its long retractile ovipositor into the centre of the corolla, for the purpose of depositing its eggs,

a, C. destructor. *b*, C. tritici. *c*, Larvæ of ditto, feeding; all magnified.

the larvæ produced from which, "perhaps by eating the pollen, prevent the impregnation of the grain, and so, in some seasons, destroy the twentieth part of the crop." Mr. Shireff has also published an interesting account of the proceedings of these insects in the Magazine of Natural History for November 1829, stating, that they were first observed (at East Lothian) on the evening of the 21st of June; and, "from the vast numbers seen, it is probable a few of them may have been in existence some days previous. The eggs were visible on the 23rd, the larvæ on the 30th of that month, and the pupæ on the 29th of July. The flies were observed depositing their eggs on the 28th, and finally disappeared on the 30th July; thus having existed throughout a period of thirty-nine days. The flies almost invariably preferred the ears emerging from the vagina to those farther advanced for depositing their eggs on, and as one side only of the ear is exposed when the plant is in this stage of growth, the other side generally remained uninjured. The fly deserted the fields as the crop advanced towards maturity, and were found longest in the spring-sown portion of the crop. It seemed to feed upon the gum adhering to the newly-emerged ears; and as there is a great diversity in the time of sowing wheat in this neighbourhood, and consequently of the ears escaping from the vagina, I attribute the unusual length of time it has existed this season to the supply of food thus gradually furnished."

Both these insects are providentially kept in due bounds by several species of parasitic flies belonging to the families *Chalcididæ* and *Proctotrupidæ*, the proceedings of which, in destroying the *Cecidomyiæ*, have been also recorded by the authors quoted above.

In these two species of *Cecidomyia*, it is to be observed, that, notwithstanding the differences in their habits, it is only in the larva state that the injury is produced; but in other species of the genus (*Cecidomyia piri, salicina*, &c.), the females, at the period of oviposition, introduce into the plant with their eggs an irritating fluid, which causes the formation of a kind of gall upon the stems. De Geer has given the history of these two insects, the latter of which is found upon a species of willow at the end of April, in the interior of a curious gall, resembling a small double rose of a green colour, occupying the extremity of one of the twigs, in the midst of which is a small conical cell formed of small leaves, in which a single larva of a yellowish red colour, without feet, is found, the body of which is composed of twelve rings, and is a little narrowed at its anterior part, with the head rounded. On the 11th of the following month of May, in the same galls, De Geer found a small white and very delicate cocoon, which inclosed, without entirely concealing, a small red pupa with white legs, and a bright red-coloured abdomen, having a darker central line. Having inclosed some of these galls in a box, several small tipulideous insects made their way out of them, which various authors, and more especially M. Macquart, whose recent work upon the *Diptera* forms a valuable manual upon this order of flies, have also observed subsequent to De Geer, and which they regard as the *Cecidomyia salicina.*

De Geer also describes the habits of three other tipulidans, nearly allied to the preceding, namely, the *Tipula juniperi* (Linnæus), which M. Meigen places doubtingly in the genus *Lasioptera*, and the *Tipulæ piri* and *loti*, which have been considered both by Latreille and Meigen as *Cecidomyiæ*. The galls of the juniper are composed of six leaves, three external, and three internal and smaller; and De Geer has observed, that, as the leaves of this plant are always placed three by three, it would seem that the gall is produced by the germ itself of three smaller leaves, which, without this attack, would have developed themselves, and ultimately produced a new shoot. The larvæ of the *Cecidomyiæ* feed upon the internal leaves, the external ones then growing to an unnatural size. In Sweden, the country people employ these galls as a remedy for the whooping cough, terming them kik-bar, which means berries for the whooping cough, boiling them in milk.

M. Macquart has also obtained the *Cecidomyia salicina* from galls very similar to those described by De Geer, which were found upon the *Salix alba.* He has also observed upon the leaves of *Artemisia abrotanum* the larva of a *Cecidomyia*, which feeds upon the ground leaves of this plant without producing any alteration or gall-like excrescence, and without inclosing itself in a cell; it, however, forms a very long cocoon, in which it becomes a pupa.

The small globular cottony balls which are often to be noticed upon the *Veronica chamædrys, Thymus serpyllum*, and *Glechoma hederacea* (ground ivy), are also caused by the attacks of these minute flies.

The author of this article has observed the proceedings, and reared a large British species, whose habits are very different from those recorded above, residing in company, in large solid galls, the substance of which is even firmer than the wood of the willow trees upon which they are found. These galls are evidently the result of the attacks of the parent fly depositing several eggs on the same spot. We observed; also, that this species is kept in check by not fewer than five or six distinct species of still smaller parasites; and it appeared quite inexplicable to us how these minute and feeble insects, unprovided as they are either with instruments for burrowing or for eating their way out of these hard galls, were enabled to effect their escape.

Under the article Aristolochiæ will be found an account of the mode of impregnation of the *Aristolochia clematitis*, observed by Professor Willdenow by means of the *Tipula pennicornis*, a species belonging to the present genus. A writer, however, in the Annual Medical Review, quoted by Messrs. Kirby and Spence, doubts the accuracy of this fact, on the ground, that he could never find the *Tipula*, although the plant produced fruit two years successively at Brompton. We have observed, however, another species very plentiful in the vicinity of that village, which would, in all probability, act the part of the other species.

Let it not be said, after what has been thus stated of the ravages and other injurious properties possessed by this genus of diminutive gnats, that insects are beneath the notice of mankind, from their insignificance or trivial powers. It has indeed been well said, that the generality of mankind overlook or disregard these powerful but minute dispensers of punishment, seldom considering in how many ways their welfare is affected by them; but the fact is certain, that, should it please God to give them a general commission against us, as he did during the terrific plagues of Egypt, and should he excite them to attack at the same time our bodies, our clothing, our houses, our cattle, and the produce of our fields and gardens, we should soon be reduced, in every possible respect, to a state of the most extreme wretchedness.

Mr. Stephens has enumerated twenty-six British species, in addition to which we have captured several very elegant species, which do not appear to have yet been described by dipterologists, having the wings maculated. We have also discovered another British species of a far larger size than any of those previously described, and which we have dedicated to Mr. Kirby.

CECILIA. The last of the three families into which Cuvier divides the *ophidian* reptiles, and differing in many respects both from the snakes and the true serpents. The present group is indeed one of the most singular in the whole animal kingdom, and it is not very easy to decide with perfect certainty, to what part of the natural system it should be referred. These animals are usually called by the general name of *naked serpents*, because they have no apparent scales. In external appearance they resemble earth-worms more than they do any other creatures, and some of them are described as boring holes in the ground in the same manner that worms do. Their skin is also annulated, or marked with narrow ridges and furrows passing round the body, in the same manner as worms; and it is probable that these ridges are used for progressive motion in the same manner as those of worms. The skin also secretes a viscid slime, such as is secreted by the skin of the common earth-worm, and also by eels, and slugs.

But notwithstanding these external resemblances, and notwithstanding also that the eyes of all the species are exceedingly minute, and so covered by the skin as to be hardly visible, and that one species is perhaps altogether blind, these animals have nothing in common with worms, except those external appearances which have been noticed. They are not annulated animals, and have not the power of contracting and extending the lengths of their bodies, as is the case with worms; they are vertebrated animals, although both their organisation and their habits are very singular.

The name Cecilia, or *Cæcilia*, was formerly applied to the common brittle snake, or slow-worm, which is found in this country, and which may be considered as a sort of connecting link between the Saurian reptiles, and the harmless serpents. It has the rudiments both of shoulders and pelvis, and its ribs are united into entire rings; so that its motion, destitute of feet as it is, is not of the same kind of crawling which belongs even to the true serpents.

The Cecilia of modern naturalists are at the opposite extremity of the Ophidia, and form the connecting link between the true serpents and the footless batrachia; and as, though they are not aquatic animals, so decidedly as these are, they are still near the waters, and produce their eggs in a manner somewhat similar, there is only wanting the metamorphosis which these undergo, in order to transfer them from one class to another, or rather perhaps to separate them from both classes.

The term "naked" applies to these serpents, as contrasted with the clothing of scales possessed by the others, though correct to common observation, is not strictly true. The skin indeed seems quite naked, and, as was mentioned, it is viscous: but it is the epidermis which is so, and when that is removed the true skin is found completely covered over with very minute scales, which form the little annular rings on the skin, and are the real organs of motion in the animals.

The head of these animals is flattened, and the vent is placed about the middle of the length, so that the tail is as long as the head and body. Their ribs are very short, so as not nearly to surround the cavity, and this enables them to have much more complete motion of the spine. The articulation of the spine resembles that of fishes, of the batrachian reptiles, and partially also of the *amphisbæna* among reptiles: that is, each vertebra is made up of two cups of a conical form, having their vertices turned towards each other, and thus the cavities of the adjoining pieces are placed mouth to mouth. Those cavities are filled with elastic cartilaginous matter, and thus the joints bend freely in every direction. The only joint which forms an exception to this is the articulation of the cranium with the first vertebra, which is done by two tubercles, and thus this which is, generally speaking, the lithest of reptiles, has the neck so much stiffer than the spine, that it appears to have hardly any neck at all.

The maxillary bones completely cover, or rather fill up, the orbital fosses, so that there is only a very minute hole for each eye; and the temporal bones, in like manner, fill up the temporal fosses. There are many other peculiarities in their structure, the minute details of which would be inconsistent with the character of this work.

Those singular serpents are found only in the warmer parts of central America, by the banks of the rivers, and the borders of the marshes. It has been said that one species is met with in the island of Ceylon; but it does not appear that there is the least foundation for this. The rich and humid ground, between the forests of Guiana and the sea, are the places where these animals abound the most; though they are found in many other parts, and indeed generally in the warm places of America; and as much of that country is flooded during the rainy season, their habitation agrees remarkably well with their quadruple character of Batrachian, Saurian, Ophidian, and Fish; for they have some of the characters of all these, although that of the reptile certainly predominates. They are very harmless creatures; and if we may judge from the substances found in their stomachs, their food bears a considerable resemblance to that of earth-worms, as the contents of the canal have consisted of mud and grains of sand, with a small admixture of vegetable matter, in all the recent specimens which have been examined. There are about five species described by naturalists.

Cecilia ibiara. This is a short and thick species with a blunt muzzle, the circular folds of the skin very distinctly marked, the mouth under the snout something like the mouth of a shark, and furnished with conical teeth. This species has twenty-five very distinct rings round the body, which are rendered more conspicuous by the ridges being white, while the ground colour of the animal is black. This species is very common both in Brazil and Guiana; and it is met with in the soft and wet ground, at the depth of three feet below the surface. We should have mentioned, that when full grown it is about a foot long, and an inch in diameter.

C. tentaculata. This species has the circular folds much more numerous, but they are chiefly on the tail, where they are arranged two and two, and on the body and tail together there are about one hundred and thirty. This species is black, and marbled with white on the belly.

C. gelatinosa was the first species known and described. It is long and slender, cylindrical in the section, of a brownish colour, and marked with a lateral line. It contains between three and four hundred folds on each side. It is about a foot in length, and the thickness of one's little finger. This is the species which was described erroneously as being met with in Ceylon.

C. albiventris. The body of this species is slender, round, black, but marked on the under side with irregular patches of white and yellow. Its mouth opens below the snout, and its teeth are very short and slender.

C. lumbricoides. This is the longest and most slender of all the species. It is two feet in length, and only a third of an inch in diameter; and the rings upon it are so very minute that they cannot be seen, but by the help of a microscope. Its colour is blackish. This is the species which is said to inhabit holes in the ground, in the same manner as the common earth-worm; and in form it is certainly the most singular of vertebrated animals.

There are probably many other species besides those which we have mentioned; but from the obscurity of their habits little is or can be known respecting them, so that what has been stated must suffice for our purpose; they however form an additional curious feature in the zoology of South America, which is different from any other part of the world in every thing that it produces, even when they have so much external resemblance as to have been classed together.

CECROPIA (Linnæus). A genus of ornamental trees, indigenous to the West Indies and Brazil. Linnæan class and order *Diœcia Triandria;* natural order *Urticeæ.* Generic character: flowers in a dense spiked bundle, which has a deciduous spatha. Male flowers: calyx turbinated, angular, with two holes at top; stamens two or three, exserted through the holes; anthers oblong and four-sided. Female flowers: calyx bell-shaped, two-toothed; stamens sterile; stigma sitting; acenium attached to the calyx. The cecropia is placed in *Diœcia Diandria,* by Sprengel. They are propagated in our hothouses by cuttings, and grow best in a loamy soil.

CEDAR OF GOA is the *Cupressus Lusitanica* of Tournefort, and the *C. glauca* of Lambert. It is a native of Portugal, and requires the protection of a glazed frame in this country.

CEDAR OF LEBANON is the *Cedrus Labani* of botanists, formerly called *Pinus Cedrus* by Linnæus. It is one of the most remarkable exotic trees cultivated in this country. They were introduced as far back as 1683; and there are but few old country seats in this kingdom which do not possess a few of these cedars. Many majestic specimens are met with in different parts; but in no situation have they thriven more prosperously than at the celebrated residence of Moor Park, in Hertfordshire. So numerous and large were they on this estate that, about 1798, scores of them were felled for sale, containing four and five loads of timber in their butts only. These fine trees were mostly purchased by London builders for quartering at a low price; the timber being found far inferior to the common Scotch fir. They are trees of very striking character, and give an air of grandeur to every scene in which they appear. There are two or three varieties of this tree; some assume the conical figure of the other *coniferæ;* others extend their branches horizontally from the top of a short thick trunk, forming a dense canopy over head: others again are very much divided near the ground into many upright stems, which with their horizontal spray, form in the course of years a vast bush.

This tree is raised from seeds which ripen in England, or from seeds imported from the Levant. When got from the cones, which is a work of some difficulty, they are sowed in deep seed-pans or boxes, and when fit for removal the seedlings are placed and nursed in pots, until they are large enough to be planted out for good. While nurslings, many of them, require a stake, to which a leader must be constantly kept trained, in order to ensure a regular growth.

CEDRELEÆ. Mahogany family. A natural order of dicotyledonous plants, containing five or six genera, and about fourteen species. It is nearly allied to *Meliaceæ,* of which Decandolle makes it a subdivision, and is chiefly distinguished by its winged and indefinite seeds.

Its essential characters, according to Brown, are: calyx five-cleft, persistent; petals five, sessile, inserted at the base of a stemmiferous disk; stamens ten, inserted on the outside, below the apex of a hypogynous disk; those which are opposite the petals, sterile; anthers acuminate, bursting longitudinally; disk hypogynous, cup-shaped, with ten plaits; ovary superior, five-celled; style simple; stigma deeply four-lobed, peltate; capsule separable into five pieces, which are combined at the base, before bursting, with a short central axis; placenta central, with five longitudinal lobes; seed erect or ascending, with the apex terminated in a wing; no albumen.

The plants belonging to this order have alternate compound leaves, without stipules, and a terminal inflorescence. They possess bitter and astringent properties, combined with an aromatic principle, and in general they are useful as febrifuges.

They are found in America and India, but none have as yet been detected in Africa. The chief genera of the order are *Cedrela Swietenia, chloroxylon, Flindersia, Oxleya,* and *carapa.*

There are several species of *Cedrela,* or bastard cedar, some of which attain the height of seventy or eighty feet. The wood of these plants, which is agreeably fragrant, is one of the kinds of cedar of commerce, and is imported in considerable quantities from New Holland. This wood, which is soft and light, is hollowed into canoes, and is used for covering houses, as well as for a variety of other purposes. It is apt to communicate a peculiar flavour to liquors, and therefore cannot be made into casks for keeping spirits. *Cedrela toona* is a beautiful large tree, with a straight stem, and a smooth grey-coloured bark. It is furnished with alternate drooping leaves, twelve or thirteen inches long, and numerous small white flowers, which emit a smell like honey. It is common in Bengal, and, as already mentioned, is used for timber. This species and *Cedrela febrifuga*, have fragrant resinous barks, which are used medicinally in fevers.

Swietenia, a genus named in honour of Baron Van Swieten, at whose suggestion the Botanic Garden at Vienna was first established, contains two important species. The first of these, *Swietenia mahagoni*, possesses much interest in consequence of furnishing the mahogany of commerce. It is a lofty tree with spreading branches, bearing a fruit about the size of a turkey's egg. It grows in Jamaica, Cuba, Hispaniola, &c., and was introduced into Kew gardens early in the last century. Mahogany is imported in large quantities from Honduras and Jamaica. It varies in durability and firmness of grain, according to soil, situation, and various other circumstances. The bark of the trunk of the mahogany tree is brown, rough, and scaly, that of the branches is smooth and grey. It has a weak aromatic smell, a bitter astringent taste, and has been proposed as a substitute for Peruvian bark. From the trials which have been made of it, however, it does not seem to possess the febrifuge properties of cinchona.

The second species is *Swietenia febrifuga*, known in India under the name of *Soymida*, and called, on the Coromandel coast, the red-wood tree. It is a lofty tree, like mahogany, found in mountainous districts in India, and yielding a hard, heavy and durable wood, which is employed by the natives in the construction of their temples. The trunk is straight, and is covered with a rough grey bark, which is internally of a red colour, and which is used for dyeing brown. This bark has an astringent bitter taste, and was first brought into notice by Dr. Roxburgh, as a substitute for cinchona in the cure of intermittent fever. It has also been used as a tonic in the remittent bilious fever of India, and in cases of debility and gangrene. Its reputation, however, has not been sufficiently established, to induce practitioners in this country to prescribe it in place of Peruvian bark or quinine. In large doses it is said to occasion giddiness and stupor. An extract prepared from the bark has an appearance very similar to the kino of commerce.

Flindersia, a genus named in honour of Captain Flinders, is distinguished from the other genera of the order, by the insertion of its seeds, and the mode in which its capsules open, as well as by having its leaves dotted with pellucid glands. *Oxleya xanthoxyla* is a large tree, which yields the yellow wood of New South Wales. *Chloroxylon Swietenia* is a middle-sized tree, found in mountainous parts of the East Indies, which also furnishes a wood of a yellow colour.

CEDRUS (Barrelier). A genus separated from *Pinus*, containing two species, the cedar of Lebanon, and the deodora, a lofty timber tree, native of Nepal. Linnæan class and order *Monœcia Monadelphia;* natural order *Coniferæ*.

CELANDINE is the *Chilidonium majus* of Bauhin, and a common British plant, growing on hedge banks in many places. The flowers are yellow, and when the leaves or stalks are broken, a deep yellow coloured juice is exuded.

CELASTRINEÆ (*Celastrus*, or staff-tree family). A natural order of dicotyledonous plants, containing ten genera and upwards of one hundred known species. This order was formerly included under *Rhamneæ*, but was separated by Mr. Brown on account of the ovary being free, the calyx imbricated, and the stamens alternate with the petals. The order is allied to *Hippocrateaceæ*, but differs in the number of the stamens, and in their not being monadelphous.

The essential characters of celastrineæ are : sepals four or five, combined at the base, or imbricated ; petals four or five, alternate with the sepals, rarely wanting ; stamens equal in number to the petals, and alternate with them ; anthers two-celled ; disk large, closely surrounding the ovary ; ovary free, immersed in the disk, with three or four cells ; cells one or many seeded ; ovules erect, rarely pendulous ; style one, or wanting ; stigma two to four-cleft ; fruit superior, either with a capsule, berry, drupe, or samara, various in form ; seeds ascending, frequently provided with an arillus.

The plants belonging to the order are shrubs or trees, with simple alternate or opposite leaves, and white or greenish flowers, growing in axillary cymes or terminal racemes. They are found extensively scattered over the globe. In general, however, they inhabit the warm parts of Europe, North America, and Asia, and are not abundant within the tropics. Many are natives of the Cape of Good Hope, and a few are found in South America and New Holland. Their properties are not well known.

The order has been divided into two sections:—

1. *Staphyleaceæ*, or bladder-nut tribe, including the genera *Staphylea* and *Turpinia*. This division is, by Brongniart and others, made a separate order, characterised by its opposite pinnated leaves, which are furnished with stipules.

2. *Euonymeæ*, or spindle-tree tribe, including the genera *Euonymus*, *Celastrus*, *Elæodendron*, *Maytenus*, &c.

A third tribe, *Aquifoliaceæ* of Decandolle, is now referred to the section of monopetalous plants, and will be noticed under Ilicineæ.

Several species of *Staphylea* and *Euonymus* are valued in shrubberies as ornamental plants. *Staphylea pinnata*, common bladder-nut, is a native of Britain, and grows in thickets and hedges both in Yorkshire and Kent. It is frequently cultivated in gardens on account of its singularity, and in this way has become naturalised in some parts of the country. It is a shrub bearing graceful drooping clusters of white flowers, which are followed by a large curious fruit covered with a sort of bladder ; hence the English name of the genus. The nuts are said to possess emetic properties, and to have a sweet nauseous taste. They are hard and smooth, and are strung for beads by the Catholics in some countries.

Euonymus Europæus, common sprindle-tree or prickwood, is also a native of Britain, and grows generally in hedges and thickets. The plant is reckoned poisonous, and, when bruised, it emits a fetid odour. Its fruit or capsule is of a beautiful rose-colour, occasionally white. The coat of the seed, or arillus, is of an orange-colour, and is finely contrasted with the red or white valves of the capsule. The wood is hard and fine-grained, and is made into spindles and skewers, and, according to Linnæus, affords the best charcoal for drawing. The fruit and inner bark act as purgatives, and in large doses as emetics. The young branches of *Maytenus boaria* are used in Chile as a wash for swellings produced by the poisonous shade of the tree *Lithi.*

The species of *Elæodendron,* or olive-woods, bear considerable resemblance to the olive. The fruit of some of them yields, by expression, an oil which is used at table, and for various other purposes.

CELASTRIS. A genus of Le Heretier's, now merged in the new genus *Maytenus* of Feuillée.

CELASTRUS (Linnæus). A genus of evergreen shrubs and climbers, chiefly natives of the Cape of Good Hope. Linnæan class and order *Pentandria Monogynia;* natural order *Celastrineæ.* Generic character: calyx of five lobes; petals clawed and plain; disk glandular; stamens bearing erect egg-shaped anthers; style thick and short; stigma in three parts; capsule three-celled, one seed in each; arillus of the seed fleshy and banded. The different species of celastrus, or staff-tree, have been long in our greenhouse collections. They are pretty evergreens, and easily propagated by cuttings.

CELERY. An aquatic plant indigenous to Britain, but has been long cultivated in gardens as a salad and culinary vegetable. The wild plant has a heavy scent, somewhat similar to that of its congener, parsley, on which account it formerly had a place in the herb-border, and was used as a seasoner under the name of smallage. This herb has, however, disappeared from gardens since the Italian varieties of it has been introduced under the name of *Celeri,* or celery; and its crude and rank natural qualities being dissipated by blanching, it is rendered one of the most agreeable and wholesome of salad vegetables.

In every large domestic establishment celery, in one shape or other, is wanted every day in the year; its culture is therefore a material part of the gardener's business. One large principal crop will not suffice; there must be a constant supply, as well of blanched as green.

Celery is in its prime state for use when it is full grown, thoroughly blanched, and just before the seed stem comes forth; after that shoots up, the whole plant becomes stringy, and less succulent. The stem rises sooner or later, according as the seed is sown early or late in the first months of the year. The first sowings are made in January, and again about the beginning of March. Both these sowings are made on hotbed heat; and when large enough to handle, are pricked out on a slight hotbed, to get the plants forward for ridging out in May. Both these sowings may be small, because the plants raised from them run to seed almost as soon as they are fit for use; still, where such celery is wanted, it must be cultivated, however fugitive it may be. The next and principal sowings are made about the 1st of April and 1st of May, on warm borders of the richest soil. For the plants from these sowings nursery-beds are prepared, and on which they are carefully pricked out to gain strength before ridging out in the months of June and July. The last sowing may be made at the beginning of June; but little else than green leaves can be expected from the plants of this sowing, because the growth of young celery plants is very slow after midsummer. But as plantations are made at different periods from the April and May sowings, a pretty constant succession of fine celery will be had throughout the autumn and winter months.

For the facility of blanching celery, it is usually planted in trenches in the following manner, viz.: on an open compartment garden trenches are marked out by line, one foot wide and four feet from each other; these are digged out to the depth of ten inches, laying the earth neatly levelled on each side. The trenches being cleared out, a coat of rich rotten dung, two inches thick, is laid in the bottom, and turned in with the spade half a spit deep. This finished, plants raised from the nursery-bed, having a few of their outside leaves trimmed off, are dibbed-in five inches apart along the centre of the trench. A good soaking of water is immediately given, and repeated every other day, if necessary, till the plants have taken hold of their new place.

The dung under the roots assists the plants to grow strongly, and being planted in a trench, induces a quick growth upwards. As the leaves advance in height, they are earthed up gradually, by paring earth from the sides of the trench with a spade, and allowing it to fall towards the plants, but not too much at a time, nor letting it into the hearts of the plants. This work should always be done on dry days, because moist earth might discolour or rot the outer leaves.

Two methods are followed in blanching celery; the first is doing it gradually as the plants advance in height; the other is allowing the plants to attain their full bulk and height, and then earthing them up at once. The latter plan is said to be the best, because the plants grow quicker while unencumbered with earth than if always closely earthed up. The fact is, the first is necessary in private gardens, where great size is of little value; and the second is best in market gardens, where bulk is an object, and where the crop is cleared away wholesale, whether thoroughly blanched or not. By the time the July planted crop arrives at full height, the plants will appear to stand in ridges perhaps two feet high; and the last earthing up is done with much care, by bringing and beating up the ridge to an acute angle at top, to throw off rain, which would soak down among, and injure the hearts. This finishes the culture of the principal crop; and all the other plantings, whether earlier or later, are treated in the same way.

The later in the year celery is ridged out, the shallower the trenches are made; those planted in September need not be deeper than about six inches, the plants rarely requiring to be deeper earthed up.

Another way of blanching celery is sometimes practised in market gardens. Instead of trenches for single rows, a large, say four feet wide trench, is made and dunged as before; the plants are dibbed in rows one foot apart across the trench; and as the plants advance in height, they are earthed up by well broken soil taken from the sides. This plan answers very well, provided the crop is taken up before winter; but the flat surface of such a bed is liable to admit too much moisture for the safety of the plants after they have ceased growing.

Frost is fatal to celery, if it reach it through the ridges. Fine crops should, therefore, not be left in jeopardy; they should either be effectually covered where they stand, or be taken up and stored in sand in some secure place. By this means good celery may be had for table till late in the spring, provided the seed was sowed rather late, for early sowings run to stalk long before Christmas.

There are several varieties in cultivation, viz.:—

Italian Red and White.
Solid Stalked Red.
New Striped.
Solid Stalked White.
Giant Upright.
New Silver.

The solid white and red varieties are mostly cultivated, as being decidedly the best, whether for salad or for kitchen use.

CELESTINE, a mineral nearly resembling prismatic barytes or heavy spar. It is the *Zölestin* of Werner, and is usually divided into five sub-species. The first of these is termed Foliated Celestine. It occurs in the Calton Hill at Edinburgh, and in red sandstone at Inverness. It is frequently found in the neighbourhood of Bristol, and in the islands in the Bristol Channel, particularly in Barry Island on the coast of Glamorganshire; also in amygdaloid at Bechely in Gloucestershire; and it has been procured on the Nidd, near Knaresborough, Yorkshire. It forms a bed, about one-fourth of a fathom thick, in a coal mine, which appears to be connected with shell limestone, at Suntel in Hanover; and also near Karlshütte, on the road from Göttingen to Hanover; in the Canton of Aargau in Switzerland; in the Sysser Alps in the Tyrol; and at Montecchio Maggiore in the Vicentine.

The crystals of this mineral are middle-sized, and frequently rest on each other. They usually form a rectangular four-sided table, in which the terminal planes are bevelled. Its hardness is a tolerably accurate test of its identity as it scratches calcareous-spar, but is itself scratched by fluor-spar.

The prismatic celestine usually consists of a long, oblique, four-sided prism, and occurs in combination with sulphur in the valleys of Noto and Mazzara in Sicily.

Fibrous celestine is of a pale blue colour, and occurs massive, but it has an indistinct cleavage.

Radiated celestine is of a milk-white colour. Internally it is shining and resplendent, with a pearly lustre, slightly inclining to vitreous.

Granular celestine (*Strontiane sulphatée, calcarifère*, Hauy) is of a greenish colour. It occurrs in considerable quantities, with gypsum, at Montmartre, near Paris.

CELLULACEA (Blainville). First class *Cephalophora;* second order of Molluscs. This order includes the families,—first, *Spherulacea*, in which are included the genera *Miliola, Melania, Saracenaria,* and *Tertularia;* second family, *Planulacea*, including the genera *Renulina* and *Peneroples;* third family, including the genera *Nummulites, Helicites, Siderolites, Orbiculina, Placentula,* and *Vorticiales.* The first family are microscopic shells, and only known in a fossil state; the animal is quite unknown, but, from analogous reasoning on the form of the shells, they may be supposed to be entirely concealed in its body; second family are all fossil shells. In the third family two recent species of the *Siderolites* are known; three species of *Orbiculina*; two species of *Placentula*, and four species of *Vorticiales*, all microscopic shells.

CELLULARES. A name applied to flowerless plants, indicative of their structure, in contradistinction to *vasculares*, which has been appropriated to flowering plants. To this grand division of the vegetable kingdom the terms *Acotyledonous* and *Cryptogamous* have also been applied. See article ACOTYLEDONOUS PLANTS. The plants belonging to this division have neither flowers nor sexual apparatus; they are chiefly composed of *cellular* tissue, and have no spiral vessels, and no proper stem or trunk. In them reproduction is accomplished principally by means of bodies called *sporules*, which are sometimes enclosed in particular coverings denominated *thecæ*, and at other times are imbedded in the substance of the plants. Many of them approach very near to the lowest tribes of infusory animalcules, and sometimes can hardly be distinguished from them. The ferns constitute the link between the cellular and vascular plants.

Our knowledge of the structure and physiology of cellular and cryptogamic plants is not by any means in an advanced state; and although the labours of many able botanists have been directed to the elucidation of the subject, still much remains to reward the investigations of future inquirers.

Ferns, mosses, lichens, mushrooms, and sea-weeds, are the orders generally included in what is called *Cryptogamia.* These orders have of late been subdivided into numerous sections. Professor Lindley divides flowerless plants into three sections:—

1. *Filicoideæ*, or fan-like plants, including *Equisetaceæ*, the horse-tail tribe; *Filices*, the true fern tribe; *Lycopodiaceæ*, the club-moss, or wolf's-foot tribe; and *Marsileaceæ*, pepperwort tribe. In these tribes there exists a distinct vascular system, and the sporules are in thecæ provided for their preparation and dispersion.

2. *Muscoideæ*, moss-like plants, including *Musci*, the moss tribe; *Hepaticæ*, the liverwort tribe; and *Characeæ*, the chara tribe. In these no vascular system can be detected, but there is a central axis of development, and the sporules are as in the fern-like plants.

3. *Aphyllæ*, leafless flowerless plants, including *Lichenes*, the lichen tribe; *Fungi*, the mushroom tribe; and *Algæ*, the sea-weed tribe. In these there is neither a vascular system nor a central axis of development, but an irregular ramification of homogeneous masses, and the sporules or reproductive bodies lie imbedded in the plants, and are scattered when it is destroyed.

Such are the chief subdivisions of cellular plants recognised by botanists. Many of the tribes above mentioned are highly interesting, and well deserving of attention. We have already given an account of the sea-weed tribe (see article ALGÆ), and we shall, in the course of the work, treat of the other tribes more in detail.

CELOSIA (Linnæus). A fine ornamental genus of tropical plants long known by the name of cockscomb amaranthus. Linnæan class and order *Pentandria Monogynia;* natural order *Amaranthaceæ.* Generic character is: calyx five-parted, coloured, propped by the bracti; cupela of five teeth bearing stamens; anthers two-celled; style simple; stigma cleft; capsule cut round, many seeded. The deep red colour and conglomerated position of the flowers of this genus attracted the notice of florists at a very early period. They were, it appears, first noticed on Chinese articles of furniture brought from that country to Europe by the first traders to that distant empire. Seeds were soon inquired for, easily obtained, and safely brought to Europe, where they, as tender annuals, have been propagated ever since. The celosia, gomphrena, and amaranthus, were all at first included under the general name of amaranthus, their seeds and habit showing great resemblance. They all yield seeds freely in this country, are sowed in seed-pans placed in a hotbed in March, whence they are potted singly, first in small and afterwards shifted into larger pots, and nursed on heat till about the end of May, when they go into the greenhouse to flower.

The different modes of flowering of the amaranthaceæ are most remarkable; some are arranged in long erect or dangling branched spikes, others in compact globular heads; some are in little tufts in the axils of the leaves, and the celosia, instead of spikes or spherical heads, has its stem flattened and extended laterally; the crest compoundly waved and duplicated; and the whole thickly beset with minute bractes and flowers. This aggregated and contorted formation of the flower stem is increased by suitable culture; and many practical florists excel in bringing them to a monstrous though at the same time a most interesting size; the crest of some of these productions of skill, sometimes measuring twenty inches in length and eight or ten inches across!

CELSIA (Linnæus). A genus of hothouse and greenhouse herbaceous annuals, natives of the south of Europe, Africa, and India. Linnæan class and order *Didynamia Angiospermia;* natural order *Solaneæ.* Generic character: calyx five-cleft; corolla tube short; limb rotate, in five lobes, the two upper ones small, the lower large; stamens ascending, long-bearded; anthers incumbent, roundly-kidney-shaped, bursting upward; style bearing a capitate stigma of two lobes; capsule two-celled, two-valved; seeds rough. These are pretty little plants and flower freely under the ordinary management of a stove or greenhouse. They are usually raised from seeds.

CELTIS (Linnæus). A genus of shrubs and trees, natives of different parts of the world. Linnæan class and order *Polygamia Monœcia;* natural order *Urticeæ.* Generic character: calyx in five or six parts, style none; stigmas variously divided; drupe a one-seeded berry. The North American and European nettle-trees have been long cultivated in our nurseries, and are generally seen in pleasure-grounds and shrubberies. They deserve a place in every arboretum, as they are, strictly speaking, forest trees. Propagated by layers and seeds.

CELYPHUS (Dalmann). An extraordinary genus of dipterous insects, belonging to the section *Athericera* of Latreille, family *Muscidæ,* and sub-family *Gymnomyzides,* having the body short and thick, with the antennæ longer than the head, and apart at the base, but more especially distinguished from every other known group of dipterous insects, by the immense development of the scutellum, which is so large that it entirely covers the abdomen and wings, in which respects it resembles the hemipterous genus, *Scutellera.* The species are of a small size, being ornamented with purple and reddish tints; one only is recorded in the Règne Animal, namely, the *C. obtectus* of Dalman from Java. M. Weidemann has however described a second, and we are in possession of a third species, recently brought from the East Indies. Nothing is known of the habits of the group, but, from the great size of the scutellum, we should conceive that the insects can make but little use of their wings, which it would appear must be very inconveniently acted upon by the scutellum.

CEMBRA. The *Pinus cembra* of Linnæus.

CENCHRUS (Linnæus). A genus of grass found in different latitudes belonging to *Triandria Monogynia,* and to the natural order *Gramineæ.*

CENIA (Commelin). An annual uncultivated plant found at the Cape of Good Hope. It belongs to *Compositæ,* and is of no known value.

CENTAUREA (Linnæus). An extensive genus of European herbs mostly perennials. Linnæan class and order *Syngenesia Frustranea;* natural order *Compositæ.* Generic character: anthodium bellying, egg-shaped, scaly, scales either entire or prickly; florets of the ray neuters, and tubular; receptacle bristly; pappus, of chaffy bristles, deciduous in a ring; hilum of the seed, on the side of the base. The centaureas or napweeds are generally coarse-looking herbs, though some of the foreign ones are ornamental, and admitted into the flower-garden. The cultivated species are easily propagated either by seed or by divisions of the root. The black, brown, and greater napweeds, are common in British meadows; and the blue-bottle of our corn fields is really an elegant plant.

CENTAURIUM is the specific name of one of the *Erithræas,* and one of the most beautiful of British plants.

CENTENUS (*Tenrecs*). A genus of mammalia, belonging to the second, or insectivorous, family or division of Cuvier's great order, *Carnassiers.*

These animals are sometimes popularly denominated Madagascar hedgehogs; and they have some external resemblance to the hedgehog properly so called, but still they differ sufficiently from them, and also from all other animals, for entitling them to be classed as a separate genus. The number of species is not great; the locality in which they are found native is limited; and both the habits and the appearance are peculiar. They are not confined to the island of Madagascar, but occur in Bourbon, and Mauritius, and they may perhaps also be met with in some of the smaller islands of the Indian ocean, which lie toward the eastern coast of southern Africa; but they have not hitherto been found on continental Africa, or in any other part of the world, save the small locality above mentioned. This locality is peculiar in many parts of its natural history, especially in its zoology; and it probably contains more animals not to be met with in any other place, than any region of similar extent. As is the case with most places which contain peculiar animals, those found only in this locality generally partake of the characters of more than one genus of those met with in other parts of the world.

Tenrecs have many of the anatomical characters of hedgehogs, as well as a good deal of the general appearance. They have clavicles; and their intestines are all of small diameter, and without cæca. Their skin is also beset with bristly spines, but it is not moveable so as to enable them to roll themselves into a ball, as is the case with the others. Their teeth bear, perhaps, more resemblance to those of the mole than any other animal; only they have two incisors less in each jaw, and one grinder in each side of the upper jaw. Their four upper incisors are bent, and the six lower ones have trenchant edges, with lateral lobes; to these follow two canines in each jaw, and behind these six cheek teeth on each side, the foremost one small, and having the character of a false molar; the others larger, and with sharp tubercles on their crowns, forming true insectivorous teeth. The head is long, the muzzle pointed, the body long, but low on the legs and without any tail; the ears so short as to be hardly visible; and a slight membrane partially covering the nostrils. In their walking they are plantigrade, and consequently but slow in their motions. They have five toes on each of their feet, armed with sharp claws adapted for digging. They are nocturnal animals, feeding principally upon insects; and, what is rather singular in animals of so warm a climate, they are described as remaining dormant for three months of the year, and this too in the season of greatest heat.

This last circumstance shows the inaccuracy of any attempt to connect the activity of animals with a higher, and their dormancy with a lower temperature, at least by the general law of animated nature. The truth is, that each animal is adapted to a particular temperature, which ranges over a greater or smaller number of degrees of the thermometer according to circumstances, but which may, in the case of every animal, be exceeded either upward or downwards; and mankind find, by actual experience, that when heat is beyond a certain degree, they become languid and sleepy, in the same manner as when exposed to severe cold.

We may naturally suppose, on this general principle, that several of the smaller mammalia of tropical countries hybernate during the hot season, which, if unproductiveness be winter, is the true winter in such countries; the time when vegetation is burnt up, and many of the insect races either buried deeply in the ground, or in the egg, as preparatory for a new race against the return of the season of plenty. This adaptation of animal life to the temperature both ways, is a very beautiful instance of that adaptation and balance of all the parts, of which we have so many in every department of nature, animate and inanimate; and it very forcibly illustrates that unity of design which may be traced through the whole. In order that all the different regions of the globe may enjoy as equal a portion of the genial influence of the sun, as can possibly be enjoyed by the surface of a spherical body exposed to a single light, which can of course act upon only the half of it at any one instant, it became necessary for this purpose to throw the temperature into those different kinds of extremes of season, which we meet with in the tropical and the polar latitudes; and the effecting of this general distribution of one cause, necessarily makes an excess of heat the means of suspending and destroying life in the one extreme, just in the same manner as a deficiency produces the same result in another.

There is in this again a very remarkable instance of adaptation, for we find living and growing creatures always in proportion, not to the average temperature of the year, but to that of the particular season. In fact, the cause of the season, and of the abundance or the deficiency which that season displays, is one and the same, so that in proportion to the activity of nature generally, is the activity of life and growth of all kinds. Upon this principle, the flowers and stems fail, the insects perish, and the face of nature puts on the same appearance of desolation during the dry and burning months of the warm latitudes, as during the frost and snow of the cold; and though in the former the banks of rivers, and all other places which are supplied with moisture, continue fertile throughout the dry season, there is a corresponding local preservation of life in certain parts of the latter: the polar sea is never barren, even when the surface of it is mantled with ice and snow; and it is probable that the drought invades the waters, and thereby produces temporary sterility, to as great an extent in the tropical latitudes, as the frost and winter does in the polar ones. Birds, from the power of flight, can escape from the evil day in both localities by migrating; and fishes have rather more advantage in the cold climate than in the hot ones; because in the first they can move equatorially, so as to avoid the ice, while in the second they are apt to be left stranded, and perish of drought, or become the prey of those wading birds, which frequent the subsiding waters in such multitudes. Some of the fishes are indeed endowed with a limited power of making their way upon the dry land, in quest of new pools and streams; and there is little doubt that some of them hybernate in the warm countries as well as in the cold, just as is the case with mammalia. It is well known that eels, which do not bear the cold so well as many other fishes, hybernate in this country; and that for this purpose they seek the sludge and mud in the estuaries of the rivers, near the average point of the brackish water, at which the temperature is known to be always higher than either in the fresh of the river, or the open sea.

We have thought necessary to offer these few remarks on tropical hybernation, both as contrasted with polar, and we may add mountain hybernation, and as it appears to be a necessary part of the system of nature, partly because the hybernation of the tenrecs have often been described as a sort of anomaly or inconsistency in nature, and partly also for the purpose of showing the beauty and consistency of the system; and before we proceed to give the few details which are known of the tenrecs, we may further remark, that whenever birds come seasonably, we may rest assured that, if the country is in a state of nature, we shall meet with hybernating animals, especially if the birds resort to the place during what may be regarded as its summer. We might naturally conclude that nocturnal insectivorous animals, which are generally plantigrade and have but limited powers of locomotion, would both, from the failure of their food, and the influence of temperature, be among the first to hybernate, whether in the cold latitudes or the warm. We find that such is the case in cold countries and on lofty mountains; and the tenrecs are one instance of the same in a tropical climate, to which there is little doubt that further observation will add many more.

There are three species of this genus, differing from each other in size, in colour, and in the texture of their covering; but their habits, as far as known, are all much the same.

1. The Bristly Tenrec (*Centenus setaceus*). This is the tenrec of Buffon. It is longer in the body than the common hedgehog, and altogether a little larger, but it is more slender. The front, the top of the neck, and the shoulders, are beset with stiff bristles, annulated with black and pale yellow; and there are true ones which form a sort of crest on the nape; the back, the flanks, and the rump, are covered with stouter bristles; but even these are partly flexi-

ble, and do not come under the denomination of spines, properly so called. The cheeks, legs, and under parts of the body, are covered with whitish hairs.

2. THE SPINY TENREC (*Centenus spinosus*). This is rather smaller than the first species. All the upper part of the body is covered with spines, stiffer than those of the former, but not so much so as the spines of the hedgehog. These spines are white at their bases, reddish-brown in the rest of their length, and with black tips. The head, limbs, and under part of the body, are covered with reddish-white hair.

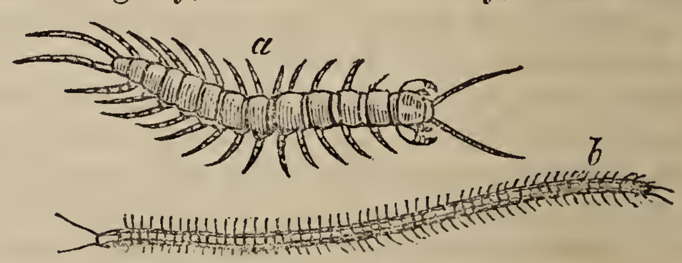
3. THE RADIATED OR VARIEGATED TENREC (*Centenus semi-spinosus*), is a much smaller species than either of the former, being only about the size of a mole, that is, about four or five inches in length. It was at first supposed to be the young of one or other of the species already mentioned: but it has since been ascertained to be distinct. The spines in this one are short and interspersed with hairs, and its markings consist of three longitudinal bands of yellowish-white upon a black ground. The spines on the nape form a sort of crest, as in the bristly species. The incisive and canine teeth of this species, are all very slender and crooked.

The whole of the species are quiet and inoffensive animals, lurking in concealment, and generally found not far from the water. The use of their bristly or spinous covering is not very well known, but it probably protects them against carnivorous animals, to whom creatures so covered would not be a very agreeable mouthful. The predatory animals of that part of the world are not however very formidable: there are none of the more powerful cats even in Madagascar; and the leading beasts of prey are said to be a species of leopard, and an animal resembling the jackall.

CENTIPEDES (Hundred-legs. SCOLOPENDRA, Linnæus). A group of annulose animals, forming the order *Myriapoda chilopoda*, divided by Latreille, Leach, &c. into several distinct genera, and distinguished from the *Julus* of Linnæus (forming the order *Myriapoda chilognatha*) by having the body flattened, membranous, composed of numerous segments, each of which is covered by a coriaceous plate, and bearing generally a single pair of legs, the last pair is turned backwards and lengthened into a pair of tails; the antennæ are more slender towards the tips, and composed at least of fourteen joints; the mouth is provided with a pair of strong curved jaws, furnished with a small appendage in the form of a palpus, and exhibiting in the centre the appearance of a soldered connexion; the lower lips are also formed of two dilated basal portions, terminated by a strong moveable claw, which is pierced at its extremity for the discharge of a supposed venomous fluid.

These animals have been considered venomous by all authors, and especially by travellers, because their bite is attended by much pain; but although the bite of the large exotic centipedes is even much more violent than that of the scorpion, it is not deadly. M. Worbe (in the Bulletin of the Philomathic Society of Paris, 1824) has published some statements which tend to prove that the bite of the *Scolopendra morritans* of Linnæus (which is termed by the inhabitants of the Antilles "le malfaisant," and "mille pattes," on the coast of Guinea) is dangerous, but it appears that by treating the wound with the application of ammonia, it is easily cured. Amoroux, the author of a work upon poisonous insects, states, however, that the ordinary centipedes of France are not provided with poison, although Leuwenhoeck, who examined the hooks of these insects, observed near their tips an orifice communicating with a cavity, which extends to the base of these organs. Be this as it may, it is evident from the common occurrence of these insects, which are met with every where, hiding themselves under stones, the barks of trees, in the ground, and especially in over-ripe fruit, creeping also into every darkened situation, and even entering beds, that they must become a very great nuisance in warm countries, where they not only abound in a greater degree than in more temperate climes, but also attain an immense size, if we may credit the account given by Ulloa, (quoted by Kirby and Spence) who states that at Carthagena these animals sometimes exceed a yard in length, and five inches in breadth, the bite of which is mortal. This, however, is evidently a traveller's wonder, for notwithstanding the more extended attention paid to exotic entomology during the last quarter of a century, we believe no species of this group have been received in Europe exceeding a foot in length, although Dr. Martin Lister, a more veracious author than the former, has figured a species eighteen inches long, and three quarters of an inch broad. In Europe, however, few species exceed two or three inches in length.

These insects, unlike the *Julidæ*, run very quickly; according to M. Veiss, quoted by Griffith, the *Scolopendra forcipata* (belonging to Dr. Leach's genus *Lithobius*), when walking, successively moves its numerous legs, one set of which are brought in contact with the line of position, whilst the others are raised up; the latter are quickly put down to the ground, and whilst the under pair of each division (comprising two segments*) is raised. All these various movements, which follow along the body from the head to the hinder extremity, produce an undulated motion. The insect varies its movements and their degree of force, according to necessity, each foot resting on the line in which it walks, and transporting the body in the same way as do the muscles of the snail, to the distance in which the limb can act. These insects are also able to run backwards with much agility, at which time they, however, make



a, Lithobus forcipatus. *b*, Geophilus longicornis.

use only of the two hind pairs of legs, which, when walking forward, are dragged motionless after the body.

These animals have been considered to be univer-

* The segments of the bodies of insects have generally two spiracles. If the bodies of the centipedes, especially those of the large exotic species, be regarded in this point of view, in which there are twenty-one pairs of legs, it will be observed, that the spiracles are placed upon alternate segments, whence, in comparison with the structure of the true insects, these segments must be considered as representing only semi-segments, from whence it is evident that each entire segment is provided with two pairs of legs, but with only one pair of breathing holes, one pair of the former organs, at the tail, being supernumerary. Mr. Mac Leay has followed up this theory of M. Latreille, in his memoir upon the thorax of insects, published in the Zoological Journal.

sally carnivorous, but from the situations in which we have repeatedly found some of the English species, we should be disposed to assign them, at least in some degree, an appetite for decaying vegetable matter. Dr. Leach has also given the name of *Geophilus carpophagus* to one of the species, from its feeding upon fruit. One of the British species, the electric centipede, (*Scolopendra electrica*, Linnæus,) possesses the remarkable property of emitting a phosphorescent light by night, nearly as bright as that of the glow-worm. We have often met with this insect in foot-paths near London, and have observed that it leaves a strong light upon the fingers when handled. It resides under stones and in moss during the day. It is about three quarters of an inch long, of a dirty buff colour, with a black line down the back. It is destitute of eyes, at least the small shining tubercles upon the head of the common scolopendra, which have been regarded by all authors as eyes, are here entirely obliterated. This is a remarkable circumstance with reference to the luminosity of the insect, as it has generally been supposed that the emission of this kind of light by insects, has for its object the enticement of the opposite sex, which in this instance would of course be unable to see or to be attracted by the light of its mate. Dr. Leach observed beneath the earth in a garden, in the month of January, a cavity containing a female of the *Geophilus subterraneus*, and twenty-six young ones, varying very much in the number of their legs; they were of a pale yellow colour, with their heads darker yellow, and the joints of their legs slightly ferruginous.—Zoological Miscellany, vol. iii. p. 44.

There are numerous small British species, of which Dr. Leach has published a very good monograph in the Zoological Miscellany, forming several genera.

CENTRANTHUS (De Candolle). A genus of herbaceous perennials, two of them British. They belong to the first class and second order of Linnæus, and to the natural order *Valerianeæ*.

CENTRARCHUS. A genus of spinous-finned fishes belonging to the perch family, and having, as their most distinguishing characters, a compressed body, with an oval section, and a produced membrane at the angle of the gills; they have also membranous spines in the anal fin, and small teeth upon the tongue. They are inhabitants of the fresh waters of America.

CENTRINA. A genus of cartilaginous fishes, belonging to the shark family, and not differing greatly in their families from the sharks properly so called. For an account of the general habits of the family we must refer to the article Squaloidæ.

CENTRISCUS. A genus of spinous-finned fishes, belonging to Cuvier's fifteenth, or last family (*Bouches en flute*), pipe-mouths, so named from the great elongation of the jaws and the smallness of the opening of the mouth. They in fact form a division, or sub-family, including all those species which have the mouth of the pipe-form, but the body compressed and oval, instead of being drawn out, as in the pipe-fishes properly so called. The fishes of this division are sometimes called sea-pies. They have the body compressed at the sides, and trenchant at the under part, and only two or three small rays in their gill-flaps. It is not very long, and indeed they are altogether fishes of small size. They have the first dorsal spinous, and small ventrical fins behind the pectorals; their mouth is extremely small, and opens obliquely. Their intestinal canal is without cæca, but it has three or four duplications; they are furnished with air-bladders of considerable size.

They consist of two genera or sub-genera, AMPHISITE, of which a notice will be found under that name. The characters of *Centriscus*, properly so called, in brief, are these: the foremost dorsal situated far backwards, and having its first spine very long and strong, and articulated to the bones of the head and shoulders, over which there are some large scaly plates, toothed in the centre. There is one species (*Centriscus scolopax*), which inhabits the Mediterranean, attains the length of some inches, and is of a silvery colour. Sailors, who sometimes catch this species as a curiosity, call it a "sea-snipe."

CENTROGASTER. A genus of spinous-finned fishes belonging to the lancet-fish family, and presenting altogether a singular appearance. Their ventral fins have a spinous ray upon each margin, and the three intermediate ones with jointed rays, as usual. They have five rays in the gill-flaps, and a crooked spine in advance of the dorsal fin. Their most singular characters, however, is in the styloid bones of the shoulders, which are prolonged, bent backwards, and connected at the extremities with the first spinous ray of the anal fins. The species of this genus are numerous, and they are all found chiefly in the warmest seas.

CENTROLOPHES. A genus or sub-genus of spinous-finned fishes, included in the group CORYPHÆNA, under which some notice will be found.

CENTRONOTUS. A genus of spinous-finned fishes belonging to the family of *Gobioidæ*. They are very nearly related to the *Blennies*, from which, however, they differ in as many respects as warrants the separation. They have their ventral fins much more minute than any of the other blennies; these organs are always without much power of action, and they sometimes consist of only a portion of one single ray. Their head is very small, their body long and blade-shaped, furnished all along the back with a fin of nearly uniform height, of which all the rays are spinous. Their teeth are crooked, pointed, and wide apart from each other, but consist of several rows.

There is one species very common on the shores of western Europe, the common gunnel, which grows to the length of from six to ten inches, is yellowish brown on the body, but whitish on the belly, and marked with a variable number of ocellated spots ranged along the base of the dorsal fin. There is also another species, larger in size, being from twelve to fifteen inches in length, brownish on the upper part and yellow on the under, and with the former mottled or marbled. This is the viviparous gunnel, or blennie, as it is called. Both species lurk among stones near the shore for great part of the year; but the viviparous ones take to the water as a surface fish, though generally in estuaries, or places near the coast, about the middle of summer. At these times it is rather provoking to amateur fishers, as it is always in the way, very ready to take their bait, and not worth the catching. Its flesh is good for nothing, and the spine has the curious property of turning green when boiled, on which account the fish is in some places called the "green bone."

CENTROPRISTES. A genus of spinous-finned fishes, belonging to the perch family, and bearing some resemblance to the sea perches. Some of them attain a considerable size. See the article PERCOIDÆ.

CENTROPUS. A species or sub-genus of climbing birds, or, at all events, of tree birds, combining the general characters of the cuckoo, with a long and straight claw on the hind toe resembling that of the lark. There are several species, all natives of the eastern continent, for some notice of which see the article CUCKOO.

CENTROTUS (Fabricius). A genus of insects belonging to the order *Homoptera* of Latreille, family *Cicadidæ*, and sub-family *Cicadellæ*, of the same author. The head is inserted very low, the antennæ are very small, and terminated by a long slender seta, and the scutellum, although covered by the prothorax, is developed. Nothing can exceed the grotesque and extraordinary forms exhibited by some of these insects, more especially those inhabiting the tropical countries, the thorax being produced into such strange and monstrous horns and spines, varying in their position and direction, that nothing parallel to them can be found in nature. In some species we find this part produced over the head into a helmet, in others the sides stand up like the ears or horns of various animals, while in not a few this part is extended over the back into a long slender tail; two of the most remarkable species are the *C. globularis*

a, C. globularis. *b*, C. cruciatus.

of Fabricius, an inhabitant of South America, which we have represented from nature, and which is about one third of an inch long, and the *C. clavatus* of Fabricius, an inhabitant of the same country, having the most extraordinary appendages in the shape of spines, balls and crescents. "What is the precise use," observe Messrs. Kirby and Spence, "of all the varieties of armour with which these little creatures are furnished, it is not easy to say, but they may probably defend them from the attacks of some animals." These insects are of small size; they feed, in the preparatory states, upon plants, employing their articulated rostrum as a sucker to pump up the juices of the leaves. Mr. Kirby has published the descriptions and figures of some extraordinary species of this genus, in the Magazine of Natural History. Like the whole of the Linnæan *Cicadidæ*, these insects are able to leap to a considerable distance. Our second figure represents another curious Brazilian species.

We possess two British species, namely, the *C. cornuta*, Linnæus, an insect which we have often met with in the early summer months upon the nut, white-thorn, &c., and which has a triangular horn on each side of the thorax, with the posterior part of the latter extended into a long and slender tail over the back. The other species, *C. genistæ* of Fabricius, is smaller, and is found upon the genista tinctoria.

CENTUNCULUS (Linnæus). The Roman name of the bastard pimpernel, a very small annual plant found on most heaths in Britain. It belongs to the natural order *Primulaceæ*.

CEPA. The specific name of the common onion.

CEPHÆLIS (Swartz). A genus of West Indian shrubs belonging to *Pentandria Monogynia* of Linnæus, and natural order *Rubiaceæ*. Generic character: flowers, aggregated in a head, having an involucrum; calyx small, of five teeth, supported by the bracti; corolla somewhat bell-shaped, throat bearded, limb in five divisions; stamens included; stigma in two parts; drupe dipyrenous.

CEPHALACANTHUS. A genus of fishes, with spinous fins, belonging to the peculiar division which Cuvier names "armed cheeks," from the strong scaly plates with which their heads are furnished. Their muzzle is very short, and has the appearance of being divided like a hare lip, with the mouth situated under it; the helmet is flat, four-cornered, and rough. They bear a considerable resemblance to the flying fishes, only, they are without the supplemental fins, or wings, as they are called, of these singular inhabitants of the ocean. There is only one known species, of small size and little value.

CEPHALANTHUS (Linnæus). A North American shrub, there called Button-wood.

CEPHALARIA (Schreber). A genus of undershrubs and herbs of various duration, natives chiefly of Europe and the Cape of Good Hope. Linnæan class and order *Tetrandria Monogynia*, natural order *Dipsaceæ*. These plants resemble the scabious, the flowers forming round heads.

CEPHALOPHORA or CEPHALOPODA (Cuvier; Lamarck). A molluscous animal, so called from having their heads furnished with long appendages, adapted to progressive motion; they have two orders of muscles, one belonging to the body, the other to the feet or tentacula. The animal's head is quite distinct from the rest of the body, and provided with all the special organs of sensation, as well as with very large sessile eyes; the body oval, sub-cylindrical or conical, naked or partly concealed in an univalve shell, constantly many chambered and without an operculum; the mouth terminal and anterior, furnished with a pair of horny teeth, acting vertically against each other, and surrounded by numerous tentacular appendages, probably used as feelers or baits to attract their prey. Organs of respiration branchial, in symmetrical pairs, and generally, if not always, concealed. The sexes separate.

This class of Molluscs, at least from all that it at present known of them, including the species of this type, are the most complete in their various parts of organisation; they, in fact, enjoy all the animal faculties—see well—hear—possess the power of moving rapidly and of pursuing and seizing their prey. This class is divided into the first order,—*Cryptodibranchiata* (two concealed branchiæ) forming the Linnæan genus *Sepia*, which is now sub-divided into the first family, *Octocera*, including the genus *Octopus*, having eight tentacular appendages; second family, *Decacera*, (ten tentacular appendages) including the genera *Loligo* and *Sepia*. Second order, *Cellulacea* (which see). Third order, *Polythalamacea* (many chambered). First family, *Orthocerata*, (like a horn) including the genera *Belemnites*, *Conularia*, *Conolites*, *Orthocerata*, and *Baculites*; second family, *Lituacea*, including the genera *Icthyosarcolithes*, (stony fish eaters) *Lituola*, *Spirula*, *Hamites*, and *Ammonoceratita*; third family, *Cristacea*, including the genera *Crepidulina*, *Orcas*, and *Linthuris*; fourth family, *Ammonacea*, including the genera *Discorbites*, *Scaphites*, *Ammonites*, and *Simplegas*; fifth family, *Nautilacea*, including the genera *Orbulites*, *Nautilus*, *Polystomella*, and *Lenti-*

culina; sixth family, *Turbinacea*, including the genera *Cibicides*, and *Botalites;* seventh family, *Turriculacea*, the genus *Turrilites*. Under the alphabetical arrangement of these species, genera, families, and orders, detailed accounts will be given of each.

CEPHALOPTERES. A genus of cartilaginous fishes, with fixed gills, belonging to the family of the rays. These are singularly-shaped fishes. The head is blunt in front, but the pectoral fins advance so much on each side of it, as to give the fish the appearance of having horns, or rather a winged head, on which account the generic name is given to it. The tail is slender and eel-shaped. A farther notice of them will be found in the article RAY, in connexion with the rest of the family.

CEPHALOTES. The brown bat of Lima, for a notice of which see the article BAT.

CEPHALOTUS (Labillardiere). A curious New Holland herbaceous aquatic plant brought to England in 1822. Linnæan class and order *Dodecandria Hexagynia*, natural order *Rosaceæ*. Generic character: calyx six-cleft and coloured; corolla none; stamens inserted in the base of the calyx; anthers twined, glandular at the back; style cylindrical; capsules six, many seeded. This, like the Nepenthes, is called a pitcher-plant, because the leaves are formed into little pitchers with beautifully fringed lids, and finely varied in colour by streaks of pink or pale purple. They are kept in frames or in a shady part of a greenhouse planted in peat earth, and surrounded by pieces of grassy turf to keep them cool and moist.

CEPHALUS—Moon-fish. A genus of fishes belonging to the order *Plectognathes*, or those which have the bones of the jaw and head soldered together, and to the division *Gymnodontes*, or those that have the jaws covered with ivory plates instead of teeth. The characters of the present genus are: each jaw united into one piece; the body compressed, incapable of being inflated, as is the case with the globe-fish, and destitute of spines; the tail so short, and ending so abruptly, that the whole body has the appearance of only the half of a fish. Their dorsal and anal fins, which are long and pointed, are united with a cordon which is exceedingly short. Three or four species of the genus are known, and one found in the European seas (*Cephalus mola*) is sometimes more than four feet in length; but, from the great thickness of the body, it weighs between three and four hundred pounds. The profile of this one is very round, but the posterior extremity appears over where the thickness is greatest. The back is short, of a bright black colour, marked with blue spots. The sides are silvery, and the fins black. The eyes are large and round. The flesh is eaten, but the animal requires to be skinned, as the skin is very thick and rough, bearing some resemblance to a piece of leather. There is another species, found chiefly in the southern Atlantic, which is more oblong, and has the skin very hard, and reticulated into a number of small angular compartments. A third species is said to be furnished with some spines. It is very small in comparison with the others. These fishes range the ocean much more extensively than their singular figure would lead one to expect. Their food is understood to consist of sea-weed and crustaceous animals.

CEPHUS (Latreille). A genus of hymenopterous insects, belonging to the section *Serrifera*, and to the family *Tenthredinidæ*, or saw-flies. The body is compressed, the antennæ thickened towards the tips, composed of about twenty joints; the posterior tibiæ spurred in the middle, and the wings have two marginal, and four sub-marginal cells. In several respects this genus materially differs from the family of the saw-flies, approaching to the genus *Sirex;* indeed the type, *C. pygmæus*, was described by Linnæus as a species of sirex. Latreille has stated that the larvæ of these flies are six-legged grubs, destitute of false abdominal legs; those of *C. abdominalis* attack the flowering buds of fruit trees, doing considerable mischief; and from some statements published in M. Ferussac's "Bulletin," it appears that the larvæ of the typical species live in the stems of wheat: in support of which we may state, that we have met with one of the species in the perfect state, in some abundance, in wheat fields. The insects, of which there are about a dozen British species, are of moderate size, and are ornamented with bands of yellow on a black ground.

CEPOLA. A genus of spinous-finned fishes, belonging to the eighth family of the order. They are riband fishes, and forming the characteristic species of that division. It gets its common name from the brightness of its colours, and the wavy bands which mark the sides. It is also, for the same reason, sometimes called the band-fish. These fishes have the body elongated and flat; the dorsal and anal fins very long, and the caudal fins very distinct. Their ventral fins are of mean length, and consist of many rays. One of their most remarkable characters is the way in which the mouth opens. The upper jaw is very short, and the under one is not only longer, but advances upwards in front, so that the mouth is on the upper part of the head, and the chin in front of the muzzle. The teeth are very pointed; the abdominal cavity is very short, but the air-bladder is long, extending to the root of the tail.

The common riband, or band-fish (*Cepola rubescens*), occurs on the south coast of England, but rarely, if ever, on the more northerly coast of Britain. It is a poor fish, and of very little value as food, but its appearance is curious, and its colours are very showy. The ground colour on the sides is carmine red, waved along the sides with glistening silvery bands. The length is about a foot on the average. The mouth large, turning upwards, as already mentioned, and furnished with a single row of curved teeth in each jaw. The eyes are large, and the aniles silvery mottled with bright red. The body tapers from the head backwards, and is smooth, and even partially transparent to appearance. Fishes which have this latter appearance are usually of but little value. This one is, however, taken in the Mediterranean, though it is in little esteem even in a country where there are many fish days in the calendar. In the water it is a very beautiful fish. It swims near the surface, gliding about like a serpent, and showing its bright colours to the greatest advantage. It is understood to subsist chiefly upon floating crustacea, and radiata, which the peculiar form of its mouth renders it very expert in seizing. For a general account of the family, see the article TÆNIOIDÆ.

CERAMBYCIDÆ (Kirby). A family of coleopterous insects, belonging to the section *Tetramera*, and to the sub-section *Capricornes* or *Longicornes*. These insects are distinguished by the great length of the antennæ, which often exceed that of the entire body; the upper lip is distinct, and reaches across the lower part of the face; the upper jaws are robust and horny, alike in both sexes; the lower jaws are terminated by two very distinct hairy lobes; the eyes are notched, or rather kidney shaped, the antennæ being inserted in the notch; the thighs are generally thick towards the tip, but slender at the bar; and the body is mostly long and narrow.

These insects are, for the most part, of a large size, and from their very great numbers, especially in tropical climates, it is evident that they must be important instruments in checking the overpowering masses of vegetation. Their forms are, in general, very elegant, and their colours much diversified. Except in the genera *Necydalis* and some of the *Callidiums* which frequent flowers, the majority are found upon the trunks of large forest trees, where they may be observed sucking up the sap which flows from the wounded parts. The females are, in general, distinguished by their larger size and shorter antennæ. In this sex also, the abdomen is terminated, in many species, by a long horny and retractile borer, with which they are enabled to introduce their eggs into the cracks and crevices of trees. In these insects we also perceive a peculiarity of structure, which is especially adapted to their mode of life. In the ground beetles, *Carabidæ*, the feet are terminated by an articulated tarsus, composed of several long and slender joints having two strong claws at the tips; but in the *Cerambycidæ*, and, in fact, in the majority of wood and plant feeding beetles, we find the feet terminated by a short tarsus, having dilated points, and furnished beneath with a spongy kind of cushion, which is evidently adapted to enable them to retain a long stationary position upon the upright stems of trees, just as the cushioned feet of the fly permit it to creep, head downwards, on the ceiling of a room. By the assistance of this piece of mechanism, the *Cerambycidæ* are able to creep up the standing trunks of trees, but their walking motions are not distinguished by that activity which is found in some of the groups of beetles, a circumstance, in a great measure, dependent upon the nature of their food, which, unlike that of the last mentioned insects, of course requires but little running after. They fly, however, with more quickness, but they may be easily captured, since they fall to the ground on meeting with the least obstruction. During the day they generally remain motionless upon the trunks of trees or in the crevices of the bark, coming forth by night for the purpose of coupling. When seized by the hand, they make a sharp and tolerably loud sound, by rubbing the inner lining of the thorax against the base of the abdomen which is introduced into the thoracic cavity; the motions which the insect makes in raising or lowering the head, causes the posterior part of the thorax to rub against the base of the abdomen, and so to produce the sound in question.

It is during the larva state that these insects are the most injurious to timber, boring it through and through in various directions. These larva are white fleshy grubs, the body narrowed behind, composed of twelve distinct segments, the head broad, horny, and armed with two short but very robust jaws, with which they gnaw their way through the wood, they have also six almost rudimental legs. The antennæ which, in the perfect state, are such conspicuous and beautiful organs, are, in the larva, scarcely visible.

An account of the ravages of one of the species of this family is recorded by Professor W. D. Peck, in the fifth volume of the Massachusetts Agricultural Repository and Journal, belonging to the genus *Stenocorus.* It appears to be diffused over a large portion of the United States, probably from Maine to Georgia, indeed, wherever the oaks, upon which it feeds, are found, it is to be met with. For several years the ground beneath the black and white oaks had been observed to be strewed with small branches of those trees from eighteen inches to two feet in length, sometimes even reaching the length of five feet, and an inch in diameter. The falling of these branches is occasioned by the larva of a species to which he gives the name of *Stenocorus putator,* which, when the duration of its existence in the larva state is nearly complete, eats away the wood in a circular direction leaving only the bark entire; this is broken by the first strong breeze, and the branch, with the larva in it, falls to the ground. From the effects of its labours it has received the name of the oak pruner. Professor Peck, in order to determine whether the larvæ descended to the earth to undergo their transformation, as might be inferred from the proceedings of the grubs, placed several branches inclosing them into a vessel nearly filled with light garden mould, imagining, that as the larva is inclosed in the fallen branch, with a sufficient supply of nutriment to carry it through the feeding state, it was intended it should enter the earth when that state was passed, and that it was therefore impelled by instinct, to eat off the branch, that it might be brought in safety to the ground, before it was quite ready to quit the wood; but this conjecture proved erroneous, whence it is evident that there must be some other reason for the process. This may perhaps be found to exist in the necessity of a degree of humidity, to favour the development of the parts of the perfect insect, whilst in the pupa state; in the body and larger branches of trees, the moisture is sufficient for this purpose, but in these small branches which are killed, the moisture would be exhaled by the action of the sun and wind, if they remained on the tree; whereas, by their falling and being thus placed nearly or quite in contact with the moist earth their humidity is preserved. It was not precisely with this view that the prepared branches were treated as above mentioned, but the purpose was attained. The vessel was kept in a warm room, the wood was kept moist and one perfect insect made its appearance in November, and another in December; but probably they would not have been disclosed before spring if the branches had remained abroad. The perfect insect itself is of a slender form, about half an inch long, of a dark brown colour, dotted with impressed points, and sprinkled everywhere with short white hairs. As the leaves are in full vigour in July preparing the descending sap, and as the greatest part of the new wood is formed after the summer solstice, the loss of leaves at this season must diminish. The trees increase in diameter in proportion to the quantity of leaves taken from them, but the falling of the branches with the larvæ in them, enables nature, though the species cannot be destroyed, to check its ravages in some degree. It is recommended to collect and burn the branches from the time they begin until they cease to fall.

The Rev. Lansdown Guilding has also published, in the thirteenth volume of the Transactions of the Linnæan Society, an interesting notice of the ravages of another species of these beetles, belonging to the genus *Lamia,* and which, from its remarkable habits, he has termed *Lamia amputator.* It is found sufficiently common in the Islands of South America, and is occasionally noticed in St. Vincent, where it was observed to make a noise by rubbing the thorax against the base of the elytra. It delights in the mimosa groves, preferring *Mimosa lebbeck*, Linn., which it attacks and prevents it from becoming too luxuriant, and thus depriving the neighbouring vegetation of the necessary supply of air. This it effects in a two-fold manner. The larva excavates the branches by means of its powerful jaws, which produce a sufficiently distinct sound when in motion, and in order the more readily to make its way through its labyrinth-like passage, it occasionally turns backwards and expels its excrement through an orifice in the branch. When it is full grown, the surface of the branch alone remains entire, the wood inside being consumed, it then forms its nest of chips of wood and becomes a pupa. The perfect insect having made its way out of the tree is not less destructive, gnawing off the branches, by cutting circularly round their axis, when the wounded branch falls to the ground at the first wind, and soon dies. It likewise wounds the bark with its jaws, in order the more readily to deposit its eggs, by means of its retractile ovipositor, in the puncture thus made.

The larva of the *Cerambyx heros* of Linnæus, is reputed to have been the Cossus of the ancients, which was served at their tables as a very favourite dish. See Cossus.

In this state the insect remains several years, and it is owing to this circumstance that, in the neighbourhood of our dock-yards, timber warehouses, &c., many very splendid exotic species of this family are occasionally found alive, having been brought from their native countries in the logs of wood. We understand that a gentleman connected with the London Docks has made a very extensive collection of such imported insects.

In the Linnæan system, the Longicorn beetles composed the three genera *Leptura*, *Necydalis*, and *Cerambyx*. Of these, the first is now formed into the family *Lepturidæ*, the second is still considered as a genus, but the last, from the vast accession of new species, exhibiting various important modifications of structure, has been divided into two great divisions, which have been regarded as families, namely, the *Pronidæ* and *Cerambycidæ*, (the genus *Necydalis*, forming part of the latter). More recently, several French authors have divided the *Cerambycidæ* into two groups, namely, the *Cerambycidæ* and *Lamiidæ*. As, however, our chief English authors have adopted the former method of distribution, it will perhaps be deemed more convenient that we should follow in their steps; premising, however, that the *Lamiidæ*, as a sub-family, are distinguished by the vertical position of the head, the filiform palpi which are not thickened at the tips, and the thorax, which is cylindrical with the sides, armed with one or more strong points.

M. Audinet Serville has just completed a revision of the characters of the *Cerambycidæ*, and some idea may be obtained of the extent of his labours and of the group itself, when it is stated, that (exclusive of the *Lamiidæ*) he has characterised not less than ninety genera of the true *Cerambycidæ*, in the annals of the French Entomological Society, for the last year. As the distinguishing peculiarities of these groups are, for the most part, structural, we shall content ourselves with this notice of them, without giving even their names, as we have generally done in such cases.

In this country we possess only fifteen genera, including those of the *Lamiidæ*, namely,—*Hamaticherus*, Meig. (*Cerambyx*, Serv.), *Cerambyx* (*Callichroma*, Latreille, *Aromia*, Serv.), *Acanthocinus*, *Monochamus*, *Pogonocherus*, *Lamia*, *Aphelocnemia*, *Saperda*, *Obrium*, *Callidium*, *Clytus*, *Tetrops*, *Tetraopes*, *Molorchus*, and *Stenopterus*.

The musk beetle, *Cerambyx moschatus* of Linnæus, has been generally considered as entitled to retain the Linnæan name of the genus, although Latreille and Serville have given it a different generic appellation, founded upon the fragrant odour which it disseminates during its living state, which has been compared to ottar of roses, and which is retained for some time after death. M. Serville states that this scent becomes more intense at the time of coupling. It is, indeed, sufficiently strong to be perceptible when walking near the tree on which the insects are standing. The name of *musk* beetle given to this species is not, however, correct, as the scent is very different from that of the drug whence its appellation is derived. The insect varies in length from an inch to an inch and a half, and is of a fine green colour, with bluish legs and antennæ. It is very abundant on willow trees in the neighbourhood of London.

C. moschatus.

CERANTHERA (Beauvois). An ever-green tropical shrub belonging to the fifth class and first order of Linnæus, and to the natural order *Violarieæ*. Generic character: calyx, upper lip marginate, the lower divided; corolla, throat inflated, upper lip long and two-lobed, the lower in three divisions; stamens standing apart and protruding; anthers incumbent, two-lobed, with awns on each side; style divided at the apex.

CERAPHRON (Jurine). A minute genus of hymenopterous insects, belonging to the section *Terebrantia*, and family *Proctotrupidæ*. The wings are furnished only with a narrow stigma, and a single nerve running from that point nearly to the tip of the wings; the antennæ of the females are composed of ten joints, of which the first is very long, and the remainder gradually thickened to the tips. According to Mr. Say, it is to a species of this genus, which he has named *Ceraphron destructor*, that the inhabitants of North America are indebted for the partial destruction of the Hessian fly (see Cecidomyia), all the species of the genus having habits very similar to those of the *Ichneumonidæ*. Latreille and Curtis have confounded a very distinct group (which we have named *Megaspilus*) with Ceraphron, and in which the antennæ are eleven-jointed, and the stigma of the upper wings very large. The species are very numerous. One of them, described by Mr. Curtis under the name of *Ceraphron Carpenteri*, is distinguished by the beautiful knotted antennæ of the males. It was reared by Thomas Carpenter, Esq., from female *Aphides*.

CERAPTERUS (Swederus). A very curious genus of coleopterous insects, belonging to the family *Paussidæ*, and composed of two or three exotic species, of whose habits we possess no information. The name of the genus is indicative of the singular structure of the antennæ, which are very broad, each being nearly half the size of the entire body, and composed of ten short flat joints. The body is small and flattened; the legs are very broad and retractile. The species are inhabitants of the East Indies and New Holland. Dr. Horsfield has also brought another supposed species from Java, which is deposited in the fine collection of insects at the East India House.

CERAPUS (Say). A genus of crustaceous insects, belonging to the order *Amphipoda*, and probably forming the type of a distinct family, having the antennæ very long and thick, the two pair being of nearly equal size, the upper four-jointed, and the inferior or lateral pair composed of five joints; the body is long, linear, and semi-cylindrical, formed of twelve segments, the last of which is armed with a small forked appendage on each side; there are seven pairs of legs, of which the anterior pair is very small, but the second pair, although short, are terminated by a broad triangular claw, with a bi-articulate finger. The genus at present consists of a single species, the *Cerapus tubularis*, described by the late Thomas Say in the Journal of the Academy of Natural Sciences of Philadelphia, vol. i. This curious animal, about half an inch long, resides in a small cylindric tube, in the same manner as the caddice worms, showing only the head, antennæ, and four anterior legs. It is found abundantly in the ocean near Egg Arbour, on the coast of the United States, in the midst of *Sertulariæ*, upon which it seems principally to feed.

CERASSUS (Jussieu). A genus of well known timber and fruit trees, found wild in many parts of the globe. Linnæan class and order *Icosandria Monogynia;* natural order *Rosaceæ.* This genus contains all the various fruits called cherries, as well as some other plants which inhabit, and to common observers, do not appear to belong to them, namely,—the common and Portugal laurels, all of which will be treated of under their proper names.

CERASTIUM (Linnæus), is a numerous genus of European weeds, commonly called mouse-ear chickweed. Some of them are pretty; but, in general, they are neglected weeds, and only interesting to the scientific botanists. They belong to the natural order *Caryophylleæ.*

CERASTUS (the Horned Viper), so called from having a pointed horn, or horny scale over each eye standing up from the eyelid. It is of a greyish colour, and found chiefly in the sandy places of Africa. See Viper.

CERATINA (Latreille). A genus of small but elegant hymenopterous insects, belonging to the family *Apidæ,* and placed by Latreille in his sub-family *Dasygastres*, or woolly-bellied bees, of which the leaf-cutter bees (*Megachile*) are the types. The maxillary palpi are, however, composed of six joints; the wings have three complete cubical cells; the body is long and narrow; the antennæ are thickened towards the tip; and the jaws have three terminal teeth. The abdomen, likewise, is destitute of that ventral clothing of down which is characteristic of the true *Dasygastres,* being in fact the organs whereby their supplies of pollen are carried to their nests. Hence M. St. Fargeau considers that this genus (being supposed to be thus destitute of pollinigerous organs) is necessarily a parasitic bee, depositing its eggs in the nests of other bees already stored with food. M. Maximilian Spinola, in his interesting account of this insect, published in the tenth volume of the "Annales du Musée," considered the small channels along the head to be organs supplying the place of the real pollinigerous organs, having observed a small portion of pollen paste upon this part of the head. M. St. Fargeau, however, considers that this was but an accidental occurrence, having observed a similar circumstance in other insects, *Lepturæ, Eristales,* and *Sesiæ,* which certainly are not pollinigerous; and indeed he affirms that the *Ceratinæ* deposit their eggs in the nests of small species of *Osmiæ* or *Heriades* (two genera of woolly-bellied bees); and if the observation of M. Spinola, that the *Ceratinæ* are noticed from time to time entering the hollow stems of plants, be correct, he considers that it is owing to the fact, that the real pollinigerous bees above mentioned had fixed upon those places for their nests, and that the *Ceratinæ* were about to deposit their own eggs in the already provided nest. Spinola, however, mentions other circumstances which seem to militate against M. St. Fargeau's opinion. Thus he states, that in breaking off the bramble branch into a hole, in which he had observed a female *Ceratinæ* enter, he found that it was perforated, and that the insect was in the very act of excavating its burrow in the pith of the branch, where it constructs a canal a foot long, and one line, or sometimes more, in diameter, with from eight to twelve cells, separated from each other by partitions of particles of pith glued together, each of which contained a supply of pollen balls kneaded with honey. As the *Ceratinæ* is stated to work only in the pith, the mandibles not being fitted for working in the hard wood, Spinola found instances in which the bee had been unable to finish her burrow in the branch of a wild rose, the pith not being of sufficient diameter.

There are not more than half a dozen species known of this interesting genus, one of which, *Ceratina cœrulea,* Villars; *cyanea,* Kirby; *albilabris,* Latreille), is an inhabitant of this country, but very rare, two other species are European, and three South American.

CERATONIA (Linnæus), is the carob tree of the Levant; Linnæan class and order *Polygamia Diœcia:* natural order *Leguminosæ;* generic character: flowers polygamous; calyx in five parts; stamens, filaments long; anthers large and double; stigma sitting and headed; pod quadrangular, unequal in breadth, containing a mealy pulp. The old trivial name of this fruit is called St. John's bread, it being an article of diet in countries where it grows naturally; indeed, it is cultivated for economical purposes. In this country it is kept in general green-house collections, but is of no value either as a fruit or ornamental tree.

CERATOPOGON (Meigen). A genus of insects, belonging to the order *Diptera*, section *Nemocera*, and family *Tipulidæ*, and being nearly allied to *Cecidomyia*. These insects are very numerous, of small size, with the antennæ in both sexes nearly moniliform, having the last five joints elongated, and with a strong brush of hairs at the base in the males only. The eyes are lunate, and the wings laid flat upon the body when at rest, the nervures, of which the number is very small, being longitudinal. These insects are found upon hedges, brambles, flowers, &c., especially in low moist and woody situations, whence it is to be presumed, observes M. St. Fargeau, that their early states are passed in the water, although neither their larvæ, nor the nature of their transformations, had been observed. Latreille, indeed, affirms that they reside, in the larva state, in vegetable galls. Whether the latter statement has been made from direct observation or not, is not mentioned; but M. Guerin has more recently published an account of these larvæ in the second volume of the Annals of the Entomological Society of France, from which it may be inferred, bearing in mind the diversity of habits existing in the kindred genus *Cecidomyia*, that the species of *Ceratopogon* are not less varied. M. Guerin found the larvæ described by him in considerable numbers under the moist bark of decaying trees, where they appeared to form a sort of society, and some of them were already (25th August) in the pupa state. The larvæ were long and slender, of a white colour, composed of twelve segments, each of which, with the exception of the head, is furnished on the upper side with four long hairs, each bearing at its extremity a small globule perfectly spherical, opake, of a milky white colour, and having the appearance of a small pearl, the series of which, placed along the back of the larvæ, gives them a most singular appearance. The pupa is shorter than the larva, thicker towards the head, the extremity of the body remaining within the exuvium of the larva. The perfect insect proved to be a new species, to which this assiduous author gave the name of *Ceratopogon geniculatus*. He likewise described, in the same Memoir, a second new species, *C. flavifrons*, the pupa of which he had found in the moist wounds of elm trees at Passy, near Paris. When the perfect insect is ready to make its escape, the body of the pupa is protruded half out of the earthy matter in which it was placed. The skin is then split, and the new-born fly creeps out, trailing its old covering after it.

There is considerable difference in the structure of the different species. In some, forming the sub-genus *Culicoides*, the legs are slender, and not spined. These species possess, in proportion to their size, and in a surprising degree, the power of stinging the naked skin of the hand, or other exposed part of the body, as we can affirm from experience; and M. Macquart has captured one of the species in the act of sucking a gnat much larger than itself, which it had seized; whilst others, as the sub-genera *Prionomyia*, *Palpomyia*, and *Ceratopogon*, have some of the thighs very thick and spined. These are much less mischievous than the former.

CERATROPHRIS. A genus of Batrachian reptiles, of which the distinguishing characters are: the head large, the skin all over granulated, and a membranous prominence, something in the shape of a horn, upon each of the upper eyelids. They are inhabitants of the warmer parts of America.

CERBERA (Linnæus). A genus of tropical shrubs and trees, belonging to the fifth class of the sexual system, and to the natural order *Apocyneæ*. This genus is described as possessing poisonous qualities; but several of the species are cultivated in our stoves, as ornamental plants, where they flower abundantly. They strike root readily from cuttings, treated in the usual manner.

CERBERUS. A sub-genus of serpents, belonging to the genus *Coluber*, in which are comprehended all the serpents, whether poisonous or not, which have two rows of scaly plates on the tail. This species has the whole head covered with small scales, except between and over the eyes, and it has frequently single plates at the root of the tail, but not along the whole of that member, as in the boa. See COLUBER.

CERCERIS (Latreille). A genus of hymenopterous insects, belonging to the section *Aculeata*, sub-section *Fossores*, and family *Crabronidæ*, (wood and sand wasps,) and readily distinguished by the form of the abdomen, the articulations of which are narrowed at the extremity, giving this part of the body a knotted appearance; the second sub-marginal cells of the upper wings is pedunculated, and the antennæ are inserted in the middle of the face. These insects, of which the *Sphex arenaria* of Linnæus is an example, and of which we have about a dozen British species, are very ferocious in their habits. Of one of the species, *Cerceris ornata*, the Baron Walckenaer has published an interesting account in his Memoir upon the Bees composing the genus *Halictus*. Numbers of these insects make their nest in the sand in the situations where the *Halictus terebrator*, Walckenaer (*Fulvocinctus*, Kirby), have established their colonies. For this purpose, the fore-legs of the female cerceris, which alone undertakes the construction and provisioning of the nest, are armed with numerous strong spines, which are employed in loosening the sand, and sweeping the loose particles away. They are thus occupied from the month of June to the commencement of September, at which latter period the *Halictus* has entirely disappeared. The entrance to these burrows, when newly constructed, is lined with an inner rampart of sand, well polished, and agglutinated with a whitish mortar, which lining is sometimes carried upwards above the surface of the ground. The entrance itself is larger than the insect, being adapted for the admission of the latter when laden with its prey. These burrows are not perpendicular, but curved somewhat in the shape of an S, being about five inches deep. When this task is completed, the deposition of the eggs, together with a sufficient supply of food for the larva when disclosed, is the next care of the parent fly; and now commences the murderous warfare with the *Halicti*, which, in fact, are employed by the cerceris for this purpose. It is only in fine hot weather, and between eleven and four o'clock, that the parent cerceris is occupied in the chace of the poor bees, one of which no sooner makes its appearance near the mouth of its own nest, on its return from a wearisome flight, than the cerceris pounces upon it, hawk-like, seizes it by the neck, dashes it to the ground, throws it upon its back, and then introduces its sting immediately beneath the head, leaving it half dead and palpitating, in which state it is buried in the burrow of the cerceris. So intent is the cerceris when thus engaged, that it will allow any one to stoop close to the ground so as the better to observe its motions. Three specimens of *Halictus terebrator*, and one of *Halictus cuprea*, serve for the nourishment of a single larva of the cerceris.

Several other species of this genus, the *Cerceris aurita*, Latreille, and *C. quadrifasciata*, Bosc, render considerable service to agriculture, by selecting several destructive kinds of weevils (*Curculionidæ*) for the supplies of their progeny; and it would seem that they have the instinct to discover these beetles at the time when their wing-cases are soft, and have not acquired their firm consistence. To convey one of these weevils to its burrow, the cerceris lays it upon its back, so that the beetle clasps the body of the cerceris with its own legs, leaving the legs of the latter free, which are employed in retaining it in this situation, and in walking.

The males have a large moustache on each side of the face, just above the jaws. The colour of these insects are black, variegated with yellow, and their length varies from one half to nearly one inch.

CERCIS (Linnæus), is a hardy ornamental shrub or small tree, natives of both continents; Linnæan class and order *Decandria Monogynia;* natural order *Leguminosæ;* generic character: calyx pitcher shaped, gibbous below, obtusely five-toothed; corolla wings marked, divaricating, keel of two petals; stamens declining, four of them longer; anthers incumbent; style, bearing an obtuse stigma; pod long and membranaceous, many seeded, attached to the sutures. This is a handsome plant both in flowers and in foliage, and is particularly suitable for planting either singly on grass plats, or among other trees. It is remarkable for producing its tufts of purple flowers from the the bark of the trunk and branches. The plant is best raised from seed; but it may also be increased by layers.

CERCOPIDÆ (Leach. Cicadellæ, Latreille). A family of insects belonging to the order *Homoptera*, and section *Cicadaires* of Latreille, and forming that part of the great group of *Cicada*, to which Linnæus gave the name of *Ranatræ*. These insects have the head of a small or moderate size, not produced in front as in the *Fulgoridæ;* the antennæ, which are composed of only three short joints, with a long terminal seta, are inserted between the eyes; the ocelli are only two in number, and unlike the true *Cicadæ*, the individuals of neither sex are furnished with instruments for the production of that chirping noise which has rendered the latter insects so notorious, from the earliest ages of natural history. The upper wings of these insects are often opaque andcoriaceous, they are, however, of the same substance throughout, thus differing from the Linnæan *Cimices*, in which the same organs are composed of two distinct kinds of membrane. Their legs are also formed for leaping to a distance, which, in proportion to the size of the insect, seems immense: thus the cuckoo-spit insect, *Aphrophora spumaria*, which is perhaps the most active of all leaping insects, will sometimes spring two or three yards; hence taking the length of the body of this insect at one sixth of an inch, the distance is nearly 650 times greater. This is as if a person of ordinary stature were to vault through the air to the distance of about six furlongs, thus bringing to mind the feats of that friend of our childhood—him of the seven league boots. This extraordinary locomotive power is of course brought into action by the great strength of the muscles of the locomotive organs, which, in this group of leaping insects, are confined to the hind legs.

Hence it cannot be denied, that amongst the various means which have been bestowed by an all-wise Creator upon the little animals which are now the peculiar objects of our attention, for the purpose of aiding them either in escaping from the numberless enemies to which they are exposed, or of facilitating their means of procuring food; this saltatorial power which so many possess, of effecting an instantaneous change of place, is one of the most remarkable. To some great running powers are given, to others, great strength of wing, but this far exceeds the rest, and cannot be found in so surprising a degree in any other group of animated nature.

This effect is produced in different modes in different insects. Thus the cheese maggot, which is the larva of a dipterous insect (*Piophila casei*, Meig.), performs its leaps in the same manner as the salmon, by taking hold of its tail with its mouth, contracting the rings of its body, and then suddenly letting go its tail. The voracious masked larvæ of the dragon flies suddenly propel themselves forward in the water by a still more remarkable manœuvre, which is performed by no other insects. They are furnished at the extremity of the abdomen, with an apparatus of five plates, capable of opening and shutting, and in which a quantity of water is from time to time inclosed, for the purpose of the absorption of its oxygen, which having been effected, the water is violently expelled, and the insect suddenly propelled to a considerable distance. In the click beetles (*Elateridæ*) the leap is produced by the sudden jerk given to the body when the insect is laid upon its back, by forcibly striking the acute spine of the breast into the corresponding cavity of the mesosternum. In the ground fleas (*Poduridæ*), the spring is produced by the sudden striking backwards of a forked appendage, fixed beneath the extremity of the body.

It is, however, to the peculiar construction of their legs that insects are, for the most part, indebted for their saltatorial powers—of these, the tormenting flea is the most notable example. Furnished with thighs of great muscular power, having the hind legs longer than the others, with the tibiæ and tarsi strongly spined, by means of which they are well enabled to take a hold for themselves so as to take a spring, and clothed in a tough and highly polished cuirass, no wonder that it effects an escape in almost every situation, and, to use the words of a favourite French author, "Comme l'Amour, rit en sureté de la blessure qu' elle a fait, et de la colère qu' elle occasionne."

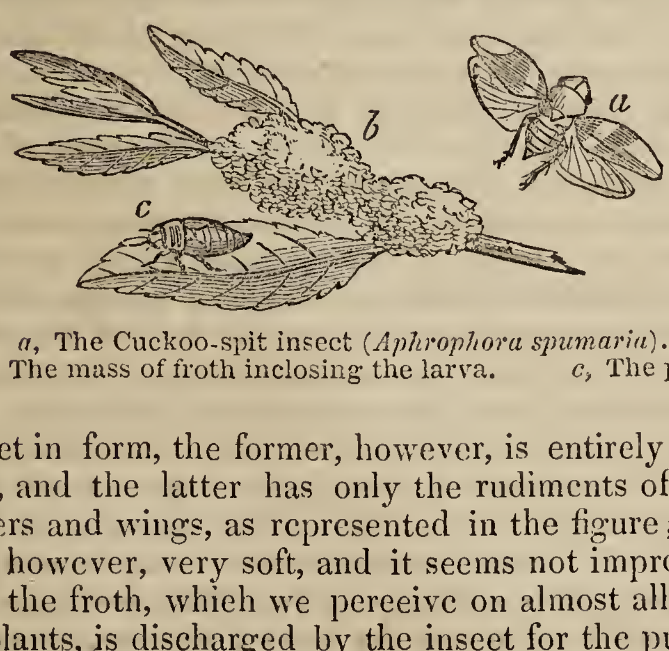
The locust, grasshopper, cricket, garden fleas, (*Halticæ*, amongst which the destructive turnip-fly is found) and the the fleawee vils (*Orchestes*) may also be mentioned as examples of leaping powers, originating in the peculiarly incrassated form of the hind legs. It is to be borne in mind, however, that many insects exist, which have thickened hind legs, but which do not possess the powers of leaping, whilst on the contrary, many species which leap well are not provided with thickened legs.

In the particular group of insects which have led to these general observations, and, indeed, in the whole of the Linnæan genus *Cicada*, now forming two families, the leaping apparatus is different from that of any other insects, and consists of a coronet of short thick spines or spurs of nearly equal size, placed round the extremity of the posterior tibia, in the midst of which, the basal part of the tarsi is implanted; besides this, some of the species have the the two basal joints of the tarsi similarly provided, and these are enabled to leap more strongly than any of the rest.

This family is divisible into two groups; first, those having the head inserted very low, the thorax very elevated in the centre, and prolonged behind into a point, and the tibiæ scarcely spined along their edges. Here are to be arranged the genera *Membracis*, (of which the body is so compressed that it is scarcely thicker than a card), *Tragopa*, *Darnis*, *Bocydium*, and *Centrotus* (which see); and second, those with the head not lower than the upper surface of the thorax, with the latter not elevated in the middle nor prolonged into a point behind, the mesothorax forming a distinct scutellum, and the tibiæ densely spined along the edges. Here belong the genera Ætalion, *Ledra*, Ciccus, *Cercopis*, *Aphrophora*, *Ulopa*, *Eupelix*, *Penthimia*, *Jassus*, Tettigonia, and some others recently established by Germar and Lewis in the first number of the Transactions of the Entomological Society of London. Those marked in italics in the second group are British.

The genus *Cercopis* is characterised by having two distinct ocelli, the head much smaller than the thorax, and the latter of a hexagonal form. This genus is of great extent, and comprises some of the largest insects in the family; their colours are also brilliant and they are chiefly inhabitants of tropical regions; one species only has hitherto been found in this country, namely, the *Cercopis vulnerata* Rossi, confounded by most Entomologists with the *Sanguinolenta* of Linnæus. Of this latter insect we are also in possession of a specimen, purchased at the sale of Mr. Donovan's collection, which has all the appearance of a British specimen, having been found amongst a quantity of English insects.

The cuckoo-spit insect or frog-hopper, (*Cicada spumaria*, Linnæus,) forms the type of Germar's genus *Aphrophora*, a name derived from the Greek, and alluding to the curious property which the larva and pupæ of this insect possess of emitting a frothy secretion, somewhat resembling saliva, which has, from a vulgar error, been termed cuckoo-spit, appearing as it does during the months when that bird visits us. The larvæ and pupæ resemble the perfect



a, The Cuckoo-spit insect (*Aphrophora spumaria*).
b, The mass of froth inclosing the larva. *c*, The pupa.

insect in form, the former, however, is entirely destitute, and the latter has only the rudiments of wing covers and wings, as represented in the figure; they are, however, very soft, and it seems not improbable that the froth, which we perceive on almost all kinds of plants, is discharged by the insect for the purpose of forming a covering against the overpowering effects of the sun. In certain seasons, this insect is so multiplied, that persons walking beneath willow trees are wetted with the continual dropping of the fluid. Another nearly allied species (*Aphrophora Goudoti* of Bennett), has recently been found in very great quantities upon trees in the island of Madagascar, the larva of which, has the power of discharging a considerable quantity of clear water, especially in the middle of the day when the heat is greatest. An account of this species has been published in the Transactions of the Society of Natural History of the island of Mauritius, for 1832, and a farther account of it appears in the proceedings of the Zoological Society of London, for January, 1833, from which it is evident that, instead of remaining as a frothy mantle, as in our British species, the fluid which has been pumped up from the trees into the stomach, is ejected in great quantities, and falls to the ground in a constant and considerable shower.

Messrs. Stephens and Curtis have given to these insects the generic name of *Tettigonia*, proposed by Fabricius for the true *Cicadæ*, but from the great confusion which has occurred in the employment of this name by various authors, we have thought it more advisable, and indeed, more correct, to adopt Germar's very appropriate name of *aphrophora*.

CERCOPITHECUS. This name, which means "tail-deep," is sometimes given to that division of the quadrumana which are furnished with such an appendage, and have it not prehensile, or adapted for laying hold. We shall, however, defer noticing the general characters, till we can bring the whole into one article, MONKEY; and the species are too numerous for our notice.

CEREOPSIS. A web-footed bird of Australia, bearing some resemblance to the bernacle goose, but having a much smaller bill, and the naked membrane at the base of the bill more enlarged, and extending more upon the forehead. Its colour is grey; it is about the same size as a goose, and very little different in its manners.

CEREUS (Haworth). This is a remarkable and highly interesting genus of South American plants; Linnæan class and order *Icosandria Monogynia*; natural order *Opuntiaceæ;* generic character: calyx bell shaped, imbricated or equal; petals of the corolla six or more, close to the calyx, campanulate and rotate; stamens numerous, joined to the petals and calyx; filaments awl shaped; anthers oval, and two celled; style and stigma radiating, or crowded, being one celled, many seeded. Many species of this fine genus, as well as several other congenial genera, were formerly included under the old name of cactus. The late A. H. Haworth, Esq., and other contemporary botanists have re-arranged this old Linnæan genus, and from it have separated four or five new ones, of which cereus is one. They have succulent stems, of very different forms, destitute of leaves, but instead thereof, many are profusely covered with spines. The flowers of all are striking, some of them magnificent, those of speciosissimus, and grandiflora particularly; and even the humble flagelliformis, seen in many a cottage window, is very showy when is full flower. It is found that by exposing these succulent plants to be hardened by the summer sun, they flower more abundantly than if always kept in the house. They grow best in a rich sandy loam, though they succeed in any garden soil, if they are kept rather dry when not in active growth, and allowed plenty of water when they are coming into flower. Hybrid varieties are easily raised by cross impregnation, several new sorts are already in the gardens, and many more, it is highly probable, will be obtained. The late Mr. Sweet was of opinion that several of the new imported species are only varieties; as where the different kinds stand closely together, which they are known to do in their native habitat, their seeds cannot fail to be impregnated by the pollen of each other. All the sorts are easily propagated by cuttings; only they require to be dried for a few days before they are planted; the fresh wound being liable to rot without this precaution. The greater number of these succulents do very well in the green-house; some few require the dry stove to flower in.

CERINTHE (Linnæus). A herbaceous annual native of Europe, called honey-wort by English herbalists. The genus belongs to the natural order *Boragineæ*.

CEROCOMA (Geoffroy). A genus of coleopterous insects, belonging to the section *Heteromera*, and family *Cantharidæ*, and distinguished by the extraordinary and irregular shape of the antennæ, which are only nine-jointed, the last joint being large and oval, the preceding joints, as well as the maxillary palpi, being of very unequal sizes, and unequally produced into various sized branches. These insects, which inhabit the warmer regions of Europe, appear often in great quantities about the summer solstice, and are found upon flowers, especially those of wild camomile, millefoil, &c. They are about three quarters of an inch long. The type is the *Meloe Schaefferi*, Linnæus.

CEROPEGIA (Linnæus). A genus of various tuberous rooted herbs, under-shrubs, and climbers, found chiefly in India. Linnæan class and order *Pentandria Digynia;* natural order *Asclepiadeæ;* generic character: calyx five parted; corolla swollen at the base, tube funnel shaped, limb cut into conniving tongues; corona double, perigynous, exterior a five lobed leaf, interior five leaved; leaflets linear bearing anthers alternately; gynostegium included. The flowers are of a curious structure and beautifully fringed; grow well in the green-house, potted in light loam and moor earth; require but little water when dormant, and at all times requiring the pots to be well drained.

CERTHIA—the tree creepers. A very interesting genus of small birds, belonging to the order *Anisodactyli* (uneven-footed creeping birds), or *Tenuirostres* of Cuvier. It is distinguished by a slender and compressed, curved, sharp-pointed, and rather long bill; narrow and tapering tongue, which is stiff and rather horny at the tip. The wings round and hollow as in the woodpeckers; the fourth and fifth feathers longest. Tail also, as in that genus, wedge-shaped, and composed of twelve stiff sharp-pointed feathers, which however are proportionably longer and weaker in the shafts than the woodpeckers, though quite stiff enough to support the much lighter comparative weight of the bird, which, in the hand, appears little more than a mass of feathers. The plumage on the upper parts is soft and very loose in its texture, the filaments of the feathers not adhering; on the under surface white, silky, and glistening. Feet, of very perfect anisodactyle construction, adapted for creeping about upon the bark of trees, with three toes before and one behind, which are rather long, the outer and middle ones united at the base; claws long, thinly compressed, and the front ones very much curved, almost semicircular, and extremely sharp-pointed, hitching into the slightest inequalities of surface; that on the hind toe is the longest, and not so much curved as the rest.

This genus was by the earlier systematists made to comprise an immense variety of species, which are now distributed into various independent genera, as *Cæreba*, *Tichodroma*, *Millephaga*, *Nectarinia*, *Cinyris*, *Climacteris*, &c. It became, in short, a general receptacle for every small bird with a slender and long curved bill, however dissimilar they might otherwise have been. By Illiger it was reduced to three or four species, to such only as exhibit the more essential generic characters above given; and some of the more eminent ornithologists of the present day are now for confining it, at least in its more restricted sense, to a single bird, the common mottled tree-creeper of this country,

C. familiaris, which is certainly the most typical bird of the kind. This species has a very wide geographical range, being found in all suitable localities within the northern temperate zone, and is equally common in Europe and North America. It is a very small bird, about five inches in length including the bill, which, in old specimens, measures rather more than half an inch; weight, about a quarter of an ounce; extent of the wings nearly seven inches. The upper parts are brown, darkest about the head, each feather having a whitish streak along the centre. Over each eye is a broad streak of whitish; the lower part of the back, rump, and tail-coverts, rusty brown; ground colour of the wings dark brown, prettily mottled with a lighter tint and with markings of pale yellowish brown. Tail brown, sometimes obscurely barred across. The under parts are of a glistening white, which is purest upon the chin and throat. The sexes are exactly similar in plumage, and the younger individuals (distinguishable by the fainter tints of the upper parts) are also very nearly about the same size, but (as seems to be the case also with the common wren, *Troglodytes Europæus*,) the male tree-creeper appears to continue growing for three or four years, as the older individuals only of this sex are often much larger than the females, and have the bill of rather more than the usual dimensions. The young of the year are, in their nestling plumage, mottled on the upper parts somewhat differently from the old birds, and they do not acquire their full beauty till the second moult, when their colours appear brighter, and the various contrasts which they afford become, in consequence, much more decided.

This curious little bird is everywhere abundantly distributed over the British islands, frequenting gardens, parks, and all places where trees are to be found. "A retired inhabitant," as a pleasing writer describes it, "of the woods and groves, and not in any way conspicuous for voice or plumage, it passes its days with us, scarcely creating any notice or attention. Its small size, and the manner in which it procures its food, both tend to secrete him from sight. In these pursuits its actions are more like those of a mouse than of a bird, darting like a great moth from tree to tree, uttering a faint trilling sound as it fixes upon their boles, running round them in a spiral direction, when, with repeated wriggles, having gained the summit, it darts to the base of another, and commences again." Its manner of flying much resembles that of the various woodpeckers, "*volatu undoso*," as White of Selborne gives it, "opening and closing the wings at every stroke, and so always rising or falling in curves." The timid retiring habits of this bird cause it to be very little noticed by people in general; but it requires only to be listened for, and its faint *tsint, tsint,* is sure to be heard in almost every clump of trees; and if watched for, it will very soon be observed, as it flits from one tree to another, alighting generally on the trunk within a few inches of the ground, and then either ascending spirally, or creeping quietly along the outline, with a rapid uniform motion, its tail bent inward towards the tree, now and then peeping round to take a glimpse at the spectator, and as soon as it thinks itself observed, disappearing behind. It will often flutter down after it has ascended a few feet, and again alight near the ground, ascending the same tree several times in different directions. This we have seen it do repeatedly, but we have never yet observed it to descend perpendicularly, or even obliquely, creeping with the head downward, though it is very commonly stated in the books to run with equal facility in all directions, upwards or downwards. It creeps with wonderful ease, however, along or across the lower side of a horizontal bough, inserting its slender bill into the cracks and crevices of the bark, and there finding abundance of minute insects and larvæ, chiefly of the coleopterous order, which, in such situations, often lurk in perfect security from the attacks of most other insectivorous birds. Sometimes the little active creeper may be descried searching about upon the topmost branches of a tall tree—sometimes it may be seen examining the smaller twigs and sprays—and sometimes, again, the same indefatigable little creature may be observed creeping about upon a mossy lichen-covered paling, pulling out minute spiders from their lurking holes, and drawing forth the tiny inhabitants of every chink and cranny. Upon such a situation the writer of this once saw one descend obliquely backwards, which rather tends to confirm his opinion that this species is unable to creep (as the nuthatch often does) perpendicularly downwards.

The foot of the common nuthatch (*Sitta Europæa*), though another beautiful example of the anisodactyle conformation (fully described in the general article Bird), is very much stouter, and more strongly formed, than that of the tree-creeper, and it has proportionably much greater power of grasping; and the whole weight of the bird (which is more equally poised than in the creeper) pressing wholly upon the feet, and not being in part supported by a stiff tail, as the creeper is, its hold is much more exclusively by the muscular contraction of the toes, whilst its claws, though larger and stronger than those of the tree-creeper, are rather less curved, and are also very far from being so sharply pointed and *hitching* as those of that bird. Thus constructed, however, the nuthatch ascends and descends the perpendicular boles of trees with equal facility; whilst the tree-creeper, notwithstanding all that has been said and written about it to the contrary, is enabled to hold on and creep upon a perpendicular surface, more from the extreme sharpness of its long, narrow, and very hooked front claws, than by any other means. When ascending perpendicularly, it requires to be further supported by its stiff deflected tail, and is thus enabled to creep in a straight downward direction. Even the hind claw, which, in the nuthatch, is curved, and adapted for taking a very firm hold when descending, in the tree-creeper is much longer and straighter than either of the others, and is fit only to assist in the ascent.

The tree-creeper, in short, appears to hold on upon the perpendicular bole of a tree much more in the manner of a cat than the nuthatch does, by means of the sharpness of its front claws, and, so far as the observation of the writer of this article goes, it can only descend a steep declivity in the same way as that animal does, backwards, the form of its claws precluding the possibility of its taking a very firm hold with the head downward; and, accordingly, though it may very commonly be observed to ascend the same tree many times successively in different directions, it never creeps down again like the nuthatch, but always flutters down again and again, as soon as it has arrived at a certain height, and re-alights, as it did the first time, near the ground.

There would appear therefore to be this difference between the only two strictly anisodactyle birds of this country, that the nuthatch holds on to the bark of a tree solely by the muscular contraction of the foot, which, as a hold, is equally available in any direction, upwards or downwards, whilst the tree-creeper hangs more as a cat does, by its very sharply-hooked front claws, and requires, therefore, to be further propped up by its tail, the stiff-pointed feathers of which, hitching upon every inequality, furnish, in conjunction with the toes, a very efficient support for so light a creature, but a support which can only be available in an ascending direction. This species is indeed so very light, that, being held up in great measure by the tail, as it creeps up the perpendicular bole of a tree, there is hardly sufficient pressure upon the foot to cause much contraction of the toes; and it is only when on the under surface of a horizontal bough, with its nadir uppermost, that the whole weight of the bird hangs by the feet; and the tendons of its legs are so admirably constructed, that the greater pull there is thus upon them, the more closely do the toes contract, and the firmer consequently is their hold, so that the bird is thus enabled to creep with its back downward with little or no muscular exertion.

The food of the creeper mostly consists of the various insects and larvæ, (chiefly coleopterous), which it finds abundantly in the crevices and chinks of the bark of trees, under the scales of the bark, and among mosses; its own incurved slender bill being unable to penetrate even into the decayed wood, it may commonly be observed, in winter, to follow in the rear of a train of titmice, gleaning up various insects and spiders which their more powerful bills had aroused and startled into day-light. The eggs of spiders also, and of various lepidopterous insects which are glued to the bark, often furnish it with a repast; and it appears also to feed on certain seeds, as these are often found in its stomach. Upon the whole, it is not only a very harmless little creature, doing no sort of injury to any property on which man sets a value, but from the immense number of injurious insects it destroys in the egg or rudimental state, it confers a real benefit to the possessors of growing timber. The peculiarity of its actions and habits, also, so unlike those of the generality of British birds, render it a very interesting object to look at, to whoever is fond of studying natural history in the wild woods.

The tree-creeper has but very little song, and most writers have described it not to have any; but in the spring months, and even in fine weather during the winter, it may often, sometimes on the wing flitting from tree to tree, and just as it settles, continuing after it has alighted, and sometimes whilst creeping up a branch, be heard to utter a faint but not unmusical sort of trill, something like the song of the chaffinch, but much shriller, more resembling the rich note of the hedge-chanter; this is often repeated several times, in a deliberative kind of manner, as the bird ascends the tree. Its nest is usually situate in a hole, or behind the bark of some decaying tree, often within two or three feet of the ground, and not unfrequently it is placed in the hollow where a limb has been broken or torn off; nature not having provided it with the means of excavating a hole for itself. It is composed of dry grass and pieces of the inner bark of wood, loosely put together, and lined with small soft feathers; the eggs, six or eight in number, are semi-transparent white, with numerous small rust coloured spots at the large end. In Wilson's ornithology of North America, the tree creeper's eggs are described to be "of a dull cinereous colour, marked with small dots of reddish yellow, and streaks of dark brown;" and this is the only particular in which his very minute description is at all at variance with the species as observed in this country; but we are inclined to notice even this slight discrepancy, never having found the eggs of our own bird to vary, and in other respects the detailed account given by that accurate observer of the plumage, and habits of the American bird, corresponds exactly and entirely with those of the common tree-creeper of Europe.

During the period of incubation, whenever the hen tree-creeper quits the nest, the male may often be seen to follow her, and offer her food; and as the young birds do not venture to fly away for some time after they begin to creep like so many mice about the tree, the sight of a nest of them at this time is particularly interesting; the old birds continually arriving with a fresh mouthful, with which they may be seen to feed their young.

There are two or three other species mentioned as approaching nearly in form to our bird, especially the *Certhia cinnamomera*, and *C. spinicauda* of authors; these are rather more strongly built than our tree-creeper, but we know little of them besides the names, and are not aware of any peculiarity in their habits which would entitle them to have here a separate description. They are inhabitants of the forest trees of warm countries, where they probably perform a very similar office to that of their northern and better known congener.

CERURA (Schrank). A genus of lepidopterous insects, belonging to the family *Bombycidæ* of Latreille (*Notodontidæ*, Steph.), and comprising the puss and kitten moths of English collectors. The body is very woolly, the wings semi-transparent, with numerous dark waves; the antennæ bi-pectinate in both sexes, and the mouth is furnished not only with a short straight tongue, but also with two pair of palpi, the maxillary ones being developed.

The caterpillars in this genus are amongst some of the most extraordinary formed British insects, having a large hump on the back, with the tail terminating in two long and toothed spines. That of the *C. vinula*, is thus quaintly described by old Izaak Walton, "which," says he, "I will show you feeding on a willow tree, and you shall find him punctually to answer this very description: his lips and mouth somewhat yellow, his eyes black as jet, his forehead purple, his feet and hinder parts green, his tail two-forked and black, the whole body stained with a kind of red spots which run along the neck and shoulder blade, not unlike the form of St. Andrew's cross or the letter X, made thus crosswise and a white line, drawn down his back to his tail, all which add much beauty to his whole body."

When about to cast their skins, they spin a web on the leaves of the poplar or willow trees upon which they have been feeding, to which they attach themselves firmly by the assistance of the hooks of the abdominal legs.

When full grown, in the course of six or eight weeks' feeding, they are about as thick as a man's thumb, and then commences the formation of the cocoon, which is so strong as to be cut with difficulty by a penknife; this cell is composed of chips of the bark of the tree upon which it is built, and which are cemented together with a glutinous matter, which quickly hardens into the firmest plaster. Many of these caterpillars, however, fall a prey to the ichneumons, which, notwithstanding the statement, that the larva endeavours to lash them off with its tail, (emitting at the same time a black fluid from the neck) contrive to deposit their eggs upon its body. An account is given of these cocoons in the Insect Architecture, pp. 195 and 326. In the former instance it is stated that "notwithstanding its strength, one of the ichneumons had *contrived to deposit its eggs in the case*," and in the latter it is stated, that in another case five empty cells (being those of the ichneumons) has been *surreptitiously introduced into* the original case of the cocoon. Both these statements are incorrect; indeed we believe no instance has yet been recorded, in which the ichneumons bore through cocoons to deposit their eggs in pupæ; and in fact the proceedings of this ichneumon (*Ophion vinulæ*) have been observed and are very extraordinary, the eggs not being deposited within, but upon the body of the larva. See Gravenhorst, Ichneumonologia, vol. i. p. 97.

The appearance of the puss moth is very elegant, the legs, which are very hairy, being stretched out in front of the body. The wings vary in expanse from two and half to three inches. There are nine British species belonging to this genus.

CESTRACIONS. A genus of cartilaginous fishes, with fixed gills, belonging to the shark family, the principal character of which is that of having pointed jaws, with sharp teeth at the middle, and larger ones at the angles of rhomboidal shape, bearing a slight resemblance to some of the spiral shells.

CESTRUM (Linnæus). A handsome genus of mostly tropical shrubs, belonging to the fifth class of Linnæus, and to the natural order *Solaneæ;* generic character: calyx pitcher shaped, five toothed; corolla funnel formed, limb plaited and five cleft; stamens inserted in the tube, often toothed; capsule one celled, many seeded. Some of the species of this genus are ornamental, most of them having fine foliage. Their qualities are said to be poisonous. The cestrum tinctorum, a native of the Caraccas, is used by the dyer. The greenhouse kinds are increased by cuttings.

CETACEA—Whales. A very singular but well defined, and to man exceedingly useful, order of mammalia. They have the internal structure, the vital functions, and the mode of production of land animals, while in external shape and in habitat they resemble fishes. Their blood is warm, warmer than that of many of the terrestrial mammalia. They have a double circulation; they breathe the free air by means of lungs; and they bring forth their young and suckle them with milk. Their bones, their muscles, in short, all the parts of their bodies, when we come to examine them, are in their textures really the parts of mammalia, only their shape has some resemblance to that of the fishes.

In their leading characters they are mammalia, altogether destitute of hind feet, or indeed any lateral appendages to their bodies, excepting short fore legs, which are formed into swimming paws. Their vertebral column is continued beyond the cavity of the body in a long and thick tail, which terminates in a very powerful fin; but this fin is very different, both in form and texture, from the fins of fishes. The muscles by which it is put in motion do not consist of a series of transverse flakes superposed upon each other, as is the case in fishes. They are longitudinal fibrous muscles like those of the land mammalia; and when, as is the case in some of the muscles of these, they are divided by septa, these are always cartilaginous, and the fibres are firmly united to them. These muscles have distinct tendons; and thus the single fin in which the tail terminates has much more range, variety, and even power of motion, than the caudal fin of a fish. The natural position of the lobes of this fin is horizontal, while that of all fishes is vertical, though there are some fishes which swim on their sides, and those have the appearance of a horizontal fin on the tail. It will be always found in those fishes, however, that when they swim with the tail thus apparently horizontal the cavity of the body is on one side; and though their necks are twisted so that both the eyes are on one side of the head in appearance, yet this twist is a permanent one; and they have no rotatory or twisting motion of the tail, which is always moved by the flexure of the joints of the vertebræ only.

The cetacea, on the other hand, have very considerable motion in that organ; they can twist it to a great number of angles; and the portion of it nearest the fin has also much more motion than that part of the tail of any ordinary fish; they can bend it upwards, downwards, laterally, or obliquely.

Their brain is larger in proportion and much better developed than the brain of fishes; their eyes have expression, which is not the case with those of any fish; and though they have very small openings, and no external production of ears, they have them tolerably well formed in the interior, and possess a distinct sense of hearing in the air, which is not, according to appearances, possessed by any fish.

Generally speaking, the cetacea are large animals, and some of them far exceed in their dimensions any other members of the animal kingdom; but there are considerable differences among them in this respect, and in other respects they differ much more. We shall point out the differences upon which the divisions and subdivisions of the order are founded; but the animals, taken altogether, are so peculiar, and have in common language been so much associated with fishes, that it may be proper first of all to take a slight structural view of the whale.

Anatomical Structure. The external form of the cetacea is not made out by that of the skeleton, as in those mammalia which have motion upon land: it is even much inferior in this respect to that of the seals and walruses, especially the former. The bones are of a loose and coarse texture, greatly inferior both in specific gravity and in strength to those of land animals. These fibres, in the larger bones such as the jaws and ribs, are easily separated; and none of them have any medullary tube or marrow in them like the round bones of land mammalia. They are, however, in most of the species very copiously supplied with oil in all these pores or openings, which supports their loose and spongy fibres.

This character of the texture of the bones is a very marked one, and a very remarkable instance of adaptation. The bones of a whale when recent and saturated with oil are not much, if anything, heavier than water; and as the whale skeleton is every where defended from the shock even of the water, by the mass of muscles and fat which make up the body to its fish-like shape, there is nothing that can very much injure their loose and comparatively weak bones. So completely indeed is the whale always carried upon elastic springs in its liquid element, that to have given it the same compact bones as animals which move upon and come in contact with solids, would have been only loading it with an unnecessary weight of salts of lime.

When the whales are seen in entire carcass, they seem to have hardly any neck; but when the skeleton is examined, they are found to have the same number of vertebræ, seven, which is common to all mammalia,—to the giraffe and the camel, as well as to the porpoise and the whale. The cetacea have not, however, the same necessity for turning or otherwise moving the head as land animals have, because they can turn the whole body in the water with much more ease than a much smaller animal standing upon feet, and thus having its weight supported at most on four points, can do upon land; and therefore they have exceedingly little motion of the vertebræ of the neck. The dolphins and porpoises have the two vertebræ nearest the head anchylosed, or soldered together; while the spermaceti whales, which are remarkable for the enormous size of their head, have the one next the back united in the same manner, so that they have hardly any motion of the neck.

The dorsal vertebræ, and with them the number of ribs, vary much in the different species, some having as many as thirteen ribs on each side, and others not more than eight. Posterior to the dorsal vertebræ there cannot be the same distinction made as in animals which have a pelvis and hind legs; but some of them have the vertebræ of this part very numerous. We find here one gradation from land mammalia through the seals to the cetacea. Seals have the hind legs and tail united so as to form a sort of fin or swimming flap, while in cetacea the whole organisation of the body, posterior to the ribs, is concentrated into the action of the tail. Analogically, therefore, we may consider the tail of a whale as combining the energies of a tail and pair of feet not merely soldered together, but actually formed into a single organ; and the length of spine and number and power of muscles which belong to this organ make it one of great efficacy; and as the proboscis of the elephant has, in reality, though a clumsy thing in appearance, more mechanical power and working in it than many hands; so the tail of a whale, huge and unwieldy as it seems, is far more curious in its action, and also far more efficient than many a pair of apparently well-formed feet.

Singular and powerful, however, as is this part of these animals, perhaps the swimming paws are even more curious. The bones are not quite the same in shape, or in relative size, as those of the human arm, but they are about the same in number, and they hold the same relative situations with regard to each other. There is a regular scapular or blade bone, a humerus, a radius, and ulna, as in the fore-arm, and there are five fingers to the hand, which, however, act all in one plane.

The whole of this curious apparatus, the only extremity which the cetacous animal has, is flattened, and the motions of the joints have not the same freedom as in land animals; but still it acts pretty readily as a clasper, the use to which it is often applied, especially by the female, which carries her young in her arms the same as the quadrumana do upon land.

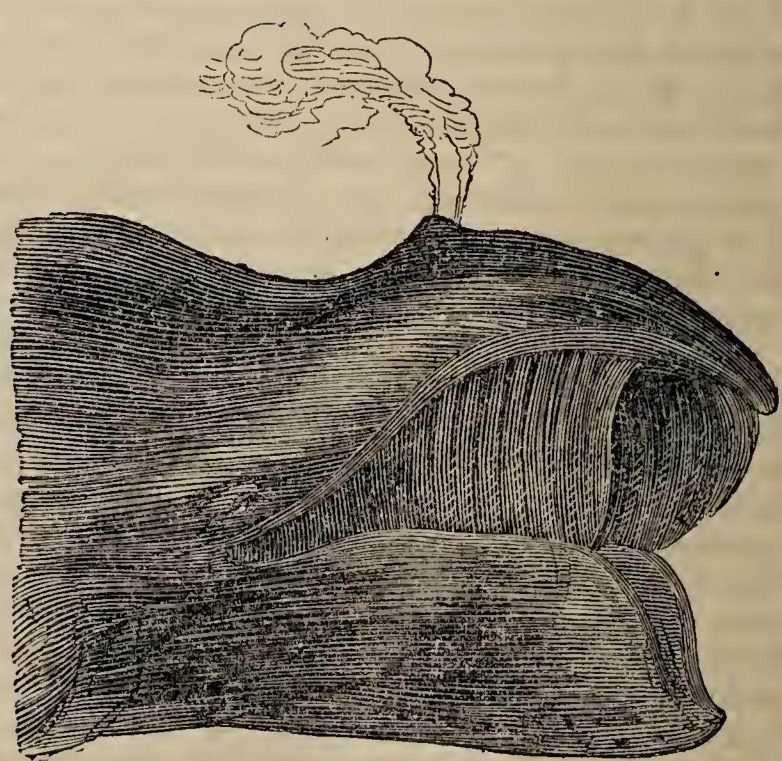
The muscles, the membranes, and all the soft textures of the cetacea, though they have very much the colour and structure of those of the larger ruminantia, and of some of the herbivorous species which are used as food, have that tendency to putrify in the air which is common to almost all animals which are inhabitants of the water. In mature animals, the flesh is hard and firm in the recent state, though stringy and dry, the fat being all accumulated in the cellular tissue under the skin; but the flesh of the young is more tender, and it is eaten with zest by the inhabitants of some of the dreary regions of the extreme north.

The tail is the most curiously organised portion of the whole animal, and it is always powerful in proportion as the head of the animal is less capable of doing violence, and the animal less inclined to attack any other living creature. This, however, is in accordance with a general law both in the water and on the land. It is well worthy of remark, both on account of the fact and the moral, that murderous animals are never what we may call "armed." Their only weapons are their feeding ones; and when we come to any animal that has what may be called a weapon for war only, whether that weapon be a horn, a spear, a spine, as in many fishes, the lancet fish family, for instance, that animal never preys upon other animals, and (unless in the battles of gallantry) never uses it but in self-defence. The tail of the whale, especially that of the common Greenland whale (see BALÆNÆ), is a very powerful weapon, but the owner of it is never the first to make an attack. The lobes of this powerful organ sometimes measure as much as twenty feet across; and they are not a merely radiated structure, covered with membrane, a sort of aquatic feathers as it were, as is the case with the fins of fishes. They consist of a very compact tissue of fine and strong tendons, elastic in so far in themselves, and pulled to their remotest extremities by the muscles to which they are attached, so that the fin has rigidity to the very extremity, and is in truth a mass of force all over. There are three layers of those tendinous fibres, one on each of the external surfaces of the fin, or lobes rather, and one internal. These can act either in concert or against each other, so that they can produce an endless number of degrees both of motion and rigidity. This organ is less powerful in most of the toothed whales than it is in the balænæ, or whalebone whales; but in the whale genus it is a very efficient instrument, having far more varied and powerful motion than the tail of any fish.

Alimentary System. When we consider the cetacea in this point of view, we feel the imperfection of even the least objectionable classifications of animals that have hitherto been made. In this respect they bear at least some resemblance to the ruminating animals; but they include in their number, portions which, in respect of their feeding apparatus, and also of the value of their food, bear a resemblance to many orders of the terrestrial mammalia. Some are herbivorous, some live on the small animals which float in the sea, and some, again, prey upon the largest fishes. The characters of the alimentary organs, at least those of the prehensile, or masticating ones, are therefore rather means of distinguishing the different groups and genera of the cetacea from each other, than as being characteristic of the whole, as an order.

In many of the smaller species, as, for instance, in the dolphins, the jaws are long, but the mouth is narrow; while in others, as in the whales properly so called, it is very broad and deep. The lengths of the jaws vary in different species; and, indeed, there are so many different forms of the head and mouth, that not one of them can be taken as part of the general character of the order.

All have not teeth; and on those that have them, some have them in one jaw, and some in both, so that there can be no general character founded on the teeth. Those that have teeth have them as prehensile instruments only, and not as organs of mastication. The food of the cetacea is therefore, generally speaking, taken into the stomach entire, and, what would not, *a priori*, be expected in swallowing animals of such large size, the throat is in general of small dimensions—that of the whalebone whale not being larger, even in specimens of the full size, than to admit a pullet's egg. The more voracious species have the gullet wider; and the dolphins, and especially the porpoises, have it wider in proportion than the true whales.



Whale's mouth.

The curious apparatus, by means of which the whalebone whales capture their prey, may be understood from the annexed cut and description, the last being in substance from the illustrious Cuvier.

The maxillary and palatial bones of the baleen, or whalebone whales, form, on their interior surface, two inclined planes, which are concave, but resemble in some respects the roof of a house inverted. It is to these bones that the blades or plates of baleen are attached. They are widest at a point of the immense mouth, which is nearer to the bottom of the gape than to the snout; and they diminish in size as they approach both extremities. They are attached to the bone by an elastic cartilaginous substance, not differing much in consistence from that by which the bones of the swimming paw and the phalanges of the fingers are united, and which perform their motions rather by the flexibility of this cartilaginous substance than by the motion of bone upon bone, which is common among land animals. This is characteristic of an aquatic joint, and in fact one of the best distinctions of a structural kind between land and water mammalia. The extremities of the latter are not, in the native element of the animals, props by means of which they have to support the weight of their bodies; these are supported by the whole surface, and thus the moveable member has nothing to support but its own weight; and as that weight is very little different from that of water, the member moves very freely on its cartilaginous pedicle, and the same motion is produced by a far less violent muscular effort than is necessary in land animals. In this way the aquatic tribes have an advantage; they having only to move, while the land ones have to carry their own weight at the same time.

The laminæ of the baleen or whalebone, have motion on those peduncles, but it is doubtful whether this motion is voluntary. When the mouth is shut the plates fall down upon the inclined planes of the palate in an imbricated manner, and when the mouth is opened, they hang down with their points touching the tongue.

The plates are parallel to each other, and have a transverse direction with respect to the axis of the body. Several hundred of laminæ may be counted on each side, and in the Greenland whale they often exceed ten feet in length. They are fixed to the bone by a kind of fleshy or ligamentous substance. Each lamina presents on its internal side a layer of horny fibres, growing from the horny plates, but less fine and more divided than the plates from which they proceed. These fibres extend between the plates, and form a fringe or loose border on the lower part, so that the whole palate is covered with fringes, the tips of which rest upon the upper surface of the tongue.

This last organ is large in all the species, but it is especially so in the whalebone whales, in which it is popularly, and not inaptly, compared to a feather bed. It consists partly of muscle and partly of fat; and it is a portion of the animal which their enemies attempt to seize with great avidity. This vast tongue is convex on the upper part, so that it applies to the points of all the fibres of the whalebone; and it is necessary to take both into consideration, in order properly to understand the economy of this vast and singular mouth.

The plates of whalebone consist of an immense number of fibres slightly soldered together, and covered with an epidermis in the living animal; but whether this epidermis is endowed with sense either of taste or of touch, is not ascertained; but it is not very probable, neither is it likely, that the cartilaginous peduncles by which the plates are attached to the roof of the mouth, are possessed of the same sensibility as the bulbs which are at the roots of the hairs of land animals. There is no question, however, that the tongue is a sentient organ: and that through its whole length it is enabled to distinguish between substances that are fit for being conveyed to the gullet, and those which require to be ejected between the blades of whalebone. The sense which it has cannot, however, be considered as quite analogous to what we call the sense of tasting; because the substances which pass over it do so in the entire state, and there is little taste in any entire animal, in one sense of the word.

The form of the tongue, and of the palate with its pending plates and their fringes, gives a curious form and appearance to the mouth of the whale when it is open for feeding, and the animal generally swims with it in this state. From the form both of the upper and under part, the anterior part of the mouth, and as far backwards as the place where the blades of whalebone are longest, it presents a sort of funnel to the water, only this funnel has a curved plane for its section. The water enters in great quantity at the anterior part, but it meets with resistance from the plates, and also from the contraction made by the approach of the tongue and palate towards each other. By this means the small animals, which the water holds suspended, get entangled among the fringes, as in a net, and they are left behind, while the greater part of the water, filtered of its eatable contents as it were, escapes by the sides of the mouth towards the bottom of the gape, where the plates of bone are shorter. There is still some portion of the water that reaches an opening of the gullet, but it does not enter into that organ, and of course not into the windpipe, as no animal which breathes the air can admit water into its breathing apparatus. The water which reaches the extreme part often, and the return of it by the same passage, would intercept the current of food to the throat, which, as it comes in small quantities, must come regularly and frequently, is received into membranous sacs adapted for the purpose, and situated in the volume of the enormous head.

These sacs are furnished with muscles, by means of which the water is ejected when they become inconveniently distended; the water thus ejected passes at once into another reservoir or reservoirs, into which the air passages from the lungs open by means of valves rising upwards. When these reservoirs have received the water, a strong expiration of air from the lungs raises the valves, and blows the water up in those jets, the appearance of which forms a curious feature in the economy of these animals. The feeding thus goes on constantly, and the small quantity of water which is flowing toward the entrance of the gullet, and delivering to that orifice the food with which it is charged, gradually accumulates in the lower sacs, without in the least interrupting the breathing of the animal whose nostrils are all this while above water. But when these lower sacs become filled, the water passes into the reservoirs with which the nostrils communicate, and is got rid of in the manner it has been stated.

The same valves which prevent the water which is squeezed from the sacs into the reservoirs, from entering the lungs by the breathing passages, equally prevent the entrance of water into these organs by the pressure from without, even when the animal plunges to a great depth. In such cases, the water has of course access to the upper reservoirs, from which the water is expelled in blowing; but the valves at the lower part of these are closed the more firmly, the greater the pressure of the water; that is, the greater the depth to which the animal plunges. Hence a whale always blows when it comes to the surface after a plunge.

There is no inconsiderable resemblance between the stomach of the cetacea, and that of ruminating animals; and this holds in most varieties of the cetacea, whatever may be the nature of their food. It consists of four or five distinct cavities, the connexions between which are very like those in the ruminants. But there is this difference between them, that, in the cetacea there is no rumination, or even approach to it; the food once taken into the stomach does not again return to the mouth; and indeed there is not, even in those which have teeth in both jaws, any apparatus by which the food could be further prepared for digestion, than it is by simple capture at the first.

In the porpoises and dolphins, the species with which we are best acquainted, and have the best means of examining, as they are plentiful on many parts of the coast, indeed on all parts of it, at some seasons; in them the first stomach is the largest, and it is of an oval form, having thick convolutions on its central surface, and elevated ridges round the opening, by which it communicates with the second one. At the end of this first stomach, and connecting it with the second one, there is a short canal. The second stomach is oval as well as the first, but it is of smaller dimensions, and has its sides with rounded longitudinal and transverse ridges; and this one also communicates by a short canal with the third. The third is of much less diameter in proportion to its length than the others, and has a contrary flexure which gives it something the figure of the letter S laid flat. This portion bears some resemblance to a wide intestine, and its walls have their furrows and ridges much finer than those of the first and second. Indeed this one is generally almost smooth in its walls, and also soft and pliant in texture. The outlet of this third stomach has a coat or valvular shutter, composed of three membranes. The fourth stomach is rather round in its form, and much smaller than any of the others. It is nearly of the same structure and consistency with the third stomach.

The intestinal canal is usually very long, with many folds of the central membrane, which appears to serve as valves in propelling, or at all events preventing the return of the contents of this long and tortuous canal. This intestine becomes very small in diameter towards the final opening.

The food of the cetacea, notwithstanding the great simliarity there is in their digestive apparatus, varies considerably in consequence of the differences in their teeth and capacity of swallowing. The *Balæna* and narwhals subsist chiefly upon floating mollusca and radiata, though they also swallow great numbers of small fishes, especially herrings, one of which is about the largest morsel which can enter the throat of the black whale. The toothed whales are much more voracious. The large spermaceti whale is a very voracious animal, capable of swallowing seals, moderately sized dolphins, and most fishes; and it is said to chase and capture the white shark with great avidity, which is a remarkable instance of a huge monster of the deep preying upon an exceedingly voracious and daring one. The dolphins are chiefly fishers, in the captures of which they are rather indiscriminate; but they are usually found in crowds near the cod banks; the larger ones, which are usually styled grampuses, do not hesitate to prey upon the latter or upon seals, and they are said to tear the flesh and suck the blood of the whalebone whales, though they keep a respectful distance from the spermaceti whales. The common porpoise hunts indiscriminately all fishes which are near the shores; and it is peculiarly destructive of salmon, especially when they are ascending the estuaries of the rivers for the purpose of spawning. It is not, however, very easy to say what may, at all seasons of the year, be the food of animals but occasionally seen.

System of circulation. The system of circulation in the cetacea does not differ much in its general structure from that of land mammalia, and, indeed, the chief difference is that which runs through the whole structure, namely,—a coarser, softer, and less compact texture in the vessels of the cetacea; this is general, and we might expect it to be so, for in every order or other natural division of animals, if the division is formed with sufficient ease, we may expect a uniformity in the texture of all the parts. The chief one here is, that the heart is softer, and indicates less muscular action than that of land animals; and from this we may conclude that the circulation in the whale tribe is slower. That they have as high, or even higher temperature than land animals, is no argument against a slower circulation; because the heat is not in proportion to any motion considered simply in itself, but in proportion to the motion and the resistance with which that motion meets, taken jointly. Now, it is easy to see that an animal which has generally more than the half, and sometimes the whole of its body immersed in the water, which water must exert a very considerable resistance or pressure upon an animal of so great size; it is easy how this pressure may, with a slower circulation, produce as high a temperature as a much more rapid circulation would produce, if there wer eno other resistance than that of atmospheric air.

This is a consideration worthy of notice when we come to consider the temperature of animals, and also the effect that pressure has upon them. It is well known that animals on high mountains, where the pressure of the atmosphere is greatly diminished, are cold and languid in their circulation, and that they are much more prone to become dormant than animals which inhabit lower down; and from this we may safely conclude, that an animal under the pressure of a fluid so much more dense than the atmosphere or water is, may produee a high temperature with much smaller action of the system. There have been various attempts at theories of animal heat, as if it were brought about by some mysterious process, connected with the function of breathing; but any one who has felt the burning heat arising from the resistance offered to the circulation in the small vessels, in the case of even a common whitlow on the finger, may thereby obtain demonstrative evidence of the real source of animal heat, sufficient to overturn all the theories that ever were fancied or fabricated.

The cetacea have two ventricles and two auricles to the heart, and a pulmonic and systematic circulation, just in the same manner as all the other mammalia. But there were once some inaccurate notions on the subject of their circulation, which are still retained in many of the books made up by compilers, who, as they must go back till they clear the time of copy-right, are, very often, the means of digging old errors out of their graves, to the injury of beginners in science. The error in the present case is this:---there is, in the fœtus of all the mammalia, while it remains *in utero*, an opening in the partition which separates the two ventricles of the heart; and the blood which, in the animal after it has begun to breathe, is carried to the lungs, is not so carried in the uterine fœtus, but returns through this opening into the systematic ventricle, the lungs being then inactive. This opening was called the *foramen ovale*, and it was supposed and said that, in order to enable a warm-blooded and air-breathing animal to live under water, it was only necessary that this foramen should be kept open, and the blood would circulate, and all the functions of life be carried on without breathing; that, in fact, this foramen did remain open in the cetacea, and also in all the animals which used to be called "amphibious," and this was the cause why they could live under water.

No error can be more subversive of all that we know of the physiology of animals than this. The *fœtus in utero* does not carry on the functions of life there, because of the circulation of the blood through the foramen ovale; and that opening exists only because the lungs are not in action; and the reason why their action is not necessary is, that the blood of the fœtus undergoes the necessary aëration in the placenta; but, the moment that the umbilical cord is divided, and there is no more aëration by means of that viscus, the lungs act, and the foramen closes, and though the opening were to remain, the circulation continued through it would be death rather than life to the animal. It is not the mere circulation of the blood that is necessary to a healthy state of the animal; it is that the blood may obtain the proper action of the air, whether by lungs or any other apparatus; and if lungs be the organs, there can be no circulation under water, or anywhere else than in the free air. That the whales can remain longer under water than land animals is true; and they are enabled to do so, partly by the valves which shut down upon, and close the breathing passages, and partly also by the less energetic action of their system, which, as we have said, is to some considerable extent compensated by the re-action of the dense fluid in which they are always, in part at least, immersed.

Frogs and other batrachian reptiles, which breathe with gills in the early stage of their being, and by lungs after they undergo their change, cannot breathe under water after they have got their lungs, any more than these animals which never have gills or breathe in that fluid.

And here it is worthy of remark, as a point which is not usually adverted to, that all placental mammalia undergo a metamorphosis at their birth, not very dissimilar to that which frogs undergo, when they change from the tadpole to the perfect frog. We know less of the physiology of marsupial animals which have a double gestation—one in the internal uterus and one in the marsupium, but we can trace clearly in them, a sort of intermediate character between the placental mammalia and oviparous animals; and when we survey the whole of the living tribes, and scan the growing ones, there breaks in upon us a very wonderful light, dim in many places no doubt, but still, such as we may yet see beam on the whole economy of nature, and disclose many principles, and clear up many doubts. It is this:---*every living and growing thing, animal or vegetable, is, in some early stage of its being, so organised as that it can breathe in a liquid, whatever may be its mode of breathing when full grown.*

This principle has not been marked out, nor hitherto, we believe, so much as even enunciated; but it is one, the consideration of which we earnestly recommend to those readers who are fond of studying the working of nature, and we are strongly persuaded that they will find it true in every case. In that of the *fœtus in utero*, of all the mammalia, there is not the least doubt. The membranes by which it is enveloped are perfectly air-tight, so that the free-air cannot reach the fœtus. We know that the lungs are never inflated till the membranes are ruptured; we know, also, that there is a distinct partition between the mother and the young—nay, that this partition is double, and that not only the whole of it, but each of the pellicles of which it is made up, is perfectly air-tight. The consequence is, that there can be no breathing of the free air in the case of the fœtus of even the land mammalia, and that therefore there must be sought some use of the fluids contained in the membranes which has not yet been attended to.

We very much suspect, nay, we are quite sure, that the same will be found to be the case with the whole of the animated races, and even in the generation of the seeds of plants, until they put forth their radicle and plumula, or otherwise display to the free air some organ upon which that air can act. We mention this incidentally, and of course briefly; but it is a subject of far greater importance than any one connected with, or forming part of the history or physiology of any one order, or any one class of animals.

System of Sensation. In this system, also, the cetacea follow the law of, and are in reality mammalia. It is true that, in the larger species, and especially in those with very large heads, the mass of the brain bears a small proportion to that of the animal, and especially to that of the head, but what is of it is well developed, and it displays a distinctly fibrous texture. The whole mass of the brain is proportionally largest in the porpoise, and smallest in the great spermaceti whale; but, on the other hand, the spinal cord is larger in that whale than in any of the others—that is, larger in proportion. The nerves are also very analogous to those of the other mammalia, only, the proper olfactory nerves are wanting, and it is probable that the animals have not much sense of smell, as indeed, from their habits, they cannot have much use for it. There are some circumstances, however, which render it probable that the animals are not wholly destitute even of this sense.

As the whole surface of the skin is beset with papillæ, it is probable that the cetacea have a general sensation of touch all over their bodies, though, from the thick layer of soft fat which is accumulated under the skin, it cannot be supposed that this sense is very delicate.

The whole structure of the tongue, its size, its softness, its moistness, and the apparently great use of it in enabling them to *feel* (rather than taste) what is fit for food and what is not, would lead us to suppose that the function which this organ possesses, whatever it may be, is a very powerful one, because it is one upon which they must have considerable dependence, indeed (in the case of the whalebone whales, their only dependence) in that most important of all their functions, the finding of their food. The fact that the tongue is the largest, and also, to all appearance, most endowed with sentient qualities in the whalebone whales, which have the greatest dependence upon it, as they do not in any ease see their food, is a strong corroboration of the view now taken; but we shall be better able to notice profitably this part of the subject when we come to the enumeration of the several divisions of the order.

The sense of hearing, even that of sounds not naturally loud, is understood to be rather acute in the cetacea. They have indeed no external conchæ to their ears, as such an appendage would be rather an inconvenience to them when they plunge in the water; but otherwise, their ears are very well formed. The auditory canal and the eustachian tube are both of considerable, or rather of large diameter. The labyrinth, the semicircular canals, the cochlea, the vestibule, and the tympanum, are also well formed; and the little bones of the ear, the use of which in any animal is not very well known, are very delicately formed. The membrane which lines all the sentient part of the ear is peculiarly delicate; and the bones which support the soft parts of that organ are much more compact and solid than any others in the body. The eustachian tube communicates both with the mouth and the blow-holes; and indeed, the whole structure of the auditory organs indicates not only an acute sense of hearing, but a strong probability that the animals hear through the vibrations of the water when the head is wholly immersed in that liquid.

The eye of the cetacea is unquestionably a very delicate organ. It is very small for the size, not being larger than that of an ox, but it is exceedingly well formed. There is one peculiarity of it; whales shed no tears, for they are not furnished with lacrymal glands; but the frequent ablution of the eye in salt water, which is one of the best applications to the eyes even in man, may render the use of any saline secretions for the eye itself quite unnecessary. There is a firmness in some parts of the eye exceeding what is met with in land animals; the choroid coat is more strongly united to the sclerotic, and the choroid is in its own structure very vascular and fibrous, indicating powerful action. The crystalline lens resembles that of fishes, in being nearly spherical.

System of Integumentation. The skin of the cetacea is worthy of considerable attention. It resembles, in its general structure and composition, that of the land mammalia, consisting of an epidermis or cuticle, a mucous tissue, a true skin, and an adipose membrane, the latter containing in its cells an immense quantity of fat.

The cuticle is very like that on the sole of the human foot, composed of several layers, and altogether dense, tough, and inelastic. It is, generally speaking, smooth, and often bright and splendent, from the quantity of oil with which it is furnished. There are few hairs, scales, or other external appendages to it, but it contains a great number of pores. On the internal surface it is rough, and in the larger species it has the appearance of velvet. It is variously coloured, but, in general, it is dark on the upper parts of the animal; but in some it is spotted; and in others, as in some of the balænæ, it is piebald. Some species are half brown half white, and others are striped with black and yellow. The upper part is often brown or dusky; and, though the element in which these animals live is much more uniform in its temperature than the air, there seem to be nearly the same elimatal variations in their colour which are found in land animals. The whales of the extreme northern latitudes, as, for instance, about Spitzbergen, are almost all uniformly of a white colour; and these differences appear to be entirely climatal; or, if not so, they are occasioned by the differences of age, not of species.

The mucous tissue is much thicker than in land animals, and it is not easy to distinguish between the first layer of it and the epidermis. This, as in land animals, is the seat of colour, the real epidermis being in both perfectly transparent. There may be albinos among whales, as there are among land mammalia; but even in the purely white specimens that have been examined, there has not appeared to be that want of the mucous tissue which is found in land albinos; we must therefore consider the whiteness as the result of elimate rather than of any imperfection of structure in the animals themselves.

The outer surface of the true skin is villous, or beset with papillæ, which run into small ridges like those on the tips of the human fingers. These *villi* run in ridges, and in some of the species, the spermaceti whales especially, they are at least a quarter of an inch long. In general, the skin of these animals has but little elasticity, or, at all events, it is stretched to the full extent by the immense quantity of fat in the adipose membrane, though there are some of the species in which the elasticity is so great as to draw the skin into distinct ridges and furrows, as may be seen in the piked whales, in which the whole skin of the neck, throat, and all the under part of the body, as far as the middle of the belly, is formed into very decidedly marked transverse ridges.

The most curious part of the covering of these animals is, however, the adipose tissue, the cells of which are loaded with that immense quantity of fat which makes the animal so eagerly sought after by the fishermen. This quantity of fat varies in amount and in consistency in almost all the species, but upon the body it always consists, for the greater part, of *elain*, or soft fat; and where there is any accumulation of *stearine*, or hard fat, that is usually found in the head of the animals, and it is called by the absurd name of *spermaceti.* In the common whale, this soft fat is called the *blubber*, or *spick*, and in good-conditioned whales it is sometimes from twenty inches to two feet in thickness, though in the smaller and more active species, as in the dolphins and porpoises, it is much less. The land animal to which the fat of the cetacea has the nearest resemblance is the hog, but the fat of the cetacea is far softer than lard, and may be regarded as a substance which is perfectly *sui generis* in its mechanical structure, though, in its chemical composition, it differs little from the fat of any other of the mammalia.

System of Reproduction. In this part of their economy the cetacea are all, strictly speaking, mammalia, though they differ a good deal, the females especially, from land animals. Very little is, however, known about their mode of pairing, or the period of gestation in the female, and the conjectures which have been advanced on the subject are so palpably absurd and contradictory, as not to be worthy of any attention. The milk of the females is wholesome, and peculiarly rich, resembling, both in taste and consistency, cream rather than milk; and, strange as it may seem, it is by no means improbable that a dairy of tame whales would be an important addition to domestic economy, although the food and manner of feeding in the common whales, which are certainly the most gentle and docile of the order, would render it a very difficult matter to keep them on any part of our shores.

The young are, generally speaking, only one at a birth, though there are two in some instances. It is said that the female goes ten months, but the fact is not established upon any satisfactory evidence. Little is known of the length of their lives; but if we may judge from the analogy of land animals, which are generally, though not invariably, long-lived in proportion to their size, we might perhaps assign to the larger whales a duration of at least a thousand years. There seems to be little doubt that, in their growth, they agree with fishes rather than with, at least the majority of, terrestrial mammalia. They continue growing, not in the flesh only, but in the skeleton. This is in so far at least the case with the boas, and with some other genera of land animals; and it seems that, in all cases when this fact is well established, the animals are remarkable for length of life. All statements which are made, or indeed can be made on this part of the subject, are, however, in a great measure, conjectural, though it is well ascertained that they are, the common whale especially, very slowly-breeding animals, and have been very much thinned by the assiduity with which the fishing in the north seas has been carried on. More attention than it has hitherto received is worthy of being paid, and necessary to be paid to the growth of the bones of animals, as connected with the duration of their lives; and when this highly important subject has been investigated with the attention which it merits, it will in all probability be found that the bones of animals are the parts which first die, and which thus bring about the mortality of the whole; and that, from the time that new matter ceases to be added to the bones, not merely in the repair of them, or in the replacement of those parts which have become unfit for use, but in the enlargement of their structures, the decay of the animal may be dated. We know that all the soft parts are frequently replaced; and that there appears to be a power of replacing them, even to the latest period of the life of the animal; but in all the shorter lived species, including man in the number, the bones cease to grow at a comparatively early period. After age and decrepitude come on, there is a wasting of the bones, a taking up of their earthy parts, or salts of lime, by the absorbent system; and this is often done to an unnatural extent, so that the matter taken up in this way loads the circulation of the blood, and is thrown upon the coats of the vessels in those accumulations, to which, in common language, we give the name of ossifications, or conversions into bone.

It does not appear from the information that we have on the subject, which it must be allowed is very scanty, that the animals whose bones continue to grow are subject to these casualties, or that they ever fall into decrepitude. In toothed animals there is, indeed, a boundary set by the decay of the teeth, though in some instances, even in man, these are reproduced in the extreme old age of the individual; and the author of this article once knew a very old man, who got a new set of teeth when he was between eighty and ninety years of age, and about the same time recovered the sense of sight which, for several years previous, had been very dim and weak.

But in cases where the bones do not decay, but continue to grow, as they do in the greater number at least in the cetacea, it is not very easy to see what part of the animal can decay; and if the system goes on assimilating all the substance which is necessary, not only for the repair, but for the growth of the several parts, it is not easy to see how it can cease to live in consequence of any other than a violent death. That the cetacea partake of this durable character to a very considerable extent is certain; but how far they possess it has not been ascertained with any thing like certainty. It is, however, a subject which is well worthy of the most minute and careful examination, not only on account of the interest and value of the animals themselves, but as one of the most interesting points in the whole economy of animated nature.

This order of animals has been variously subdivided and arranged by different naturalists. Linnæus made only four genera: *Balæna*, or whale-bone whales; *Physeter*, or spermaceti whales; *Dolphinus* or dolphins, and *Monodon*, or narwhals. La Cepède, on the other hand, makes ten genera, and, besides, he has augmented the number of species apparently much beyond the truth, by introducing many which are only varieties, if they are even entitled to that character. The animals, of which it is probable that the bones continue growing for a long and indefinite period, size cannot be admitted as a ground of distinction; and colour—conspicuous in all cases—cannot, from what has been already hinted at, be very readily admitted as a specific character in these animals. We shall, therefore, take an intermediate ground of distinction, that of the character of the teeth.

Viewing them in this light, there are four divisions or sub-orders: 1, *Edentatæ*, or toothless whales; 2, *Prædentatæ*, or those with teeth in the anterior part of the upper jaw only; 3, *Subdentatæ*, or those with teeth in the lower jaw only; and, 4, *Ambidentatæ*, or those with teeth in both jaws. To these may be added, perhaps as a separate sub-order or group, those cetaceous animals which are understood to subsist chiefly, or wholly, upon vegetable food, and which are chiefly, though not exclusively, found in the rivers of the warmer parts of the world.

I. *Toothless whales.*—These consist of the common whales, *balænæ*, which have no dorsal fins, and the "finners," *balænoptera*, which have one; and some account of them is given in the article BALÆNA, so that we have now only to notice the other divisions of the order, to which the remainder of this article will be devoted. See cut on next page.

II. *With teeth in the fore part of the upper jaw only.*—These are known by the general name of *narwhals*; and their most remarkable external character is that of having one, or sometimes rudimentally two, large teeth projecting from the snout. They are, on this account, sometimes called *sea unicorns*.

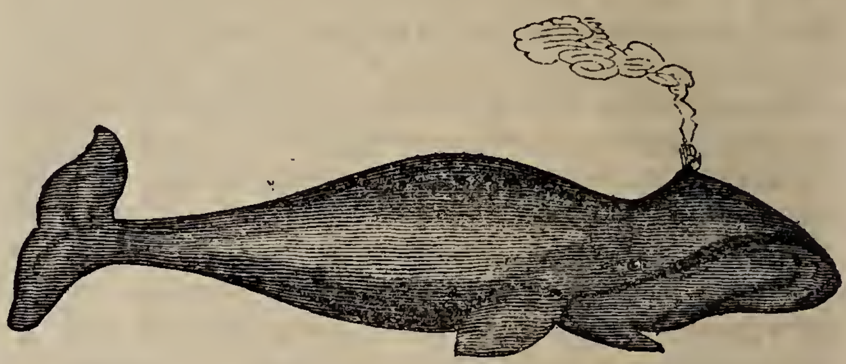
These animals have only a single opening for the blow-holes, which is situated far back on the nape of the neck, rather than on the head, The only teeth which they have are those projecting from the snout, usually one, sometimes on the right side of the snout, sometimes on the left, and very rarely two, or, if two, one of them is usually much less produced than the other. These seem, however, always to be two rudimental ones; and they are the only teeth which the animals possess. They are not of the smallest use in mastication, or in the capture of the food of the animals, farther than that they *may* sometimes use them in detaching shell-fish from the rocks, as these form a considerable part of their food. They also use them as weapons; and in this respect they are very formidable; long, strong, spirally twisted, generally sharp at the point, and formed of very compact bone or ivory. Their heads are much smaller in proportion to the size of their bodies than those of the whales properly so called; their muzzle is rounded, and they have no whalebone or horny plates in their mouth. The upper part of their body is, in general, spotted, and there is a sort of edge on the posterior part of the back, extending a considerable way from the tail; but the most typical species are without any fin on the back.

They are chiefly inhabitants of the northern or polar regions; are fast swimmers, and altogether very active animals, driving about with great velocity, and keeping all other inhabitants of the deep at a distance, by means of the formidable weapon with which their snout is armed. As they have no teeth or other instruments of division or mastication in the mouth, they do not prey upon large animals, not even on large fishes; but they are voracious in proportion to their activity, and swallow a number of the smaller fishes, as well as of radiated and molluscous animals, and they use the tooth in detaching the shelled ones from the rocks.

There are, perhaps, two sections of this division, those without a fin on the back, and those with one; and there are two, or probably more, species of each section, but their history is imperfect and obscure. Those without the fin are systematically termed *Monodon*, one tooth; and the others *Anarnacus*, from a real or supposed purgative quality of their flesh and fat. We shall first notice the species without the dorsal fin; they are *Monodon vulgaris*, the common narwhal, and *Monodon microcephalus*, the small-headed narwhal.

Monodon vulgaris.—The common narwhal grows to the length of from twenty to twenty-two feet, the general form of its body is a sort of oval, and it has a prominent ridge on the back, extending all the way from the tail to the blow-holes at the nape. Specimens of much larger dimensions than those above stated have been mentioned, but it does not appear that the accounts of them are very well authenticated. Indeed, the whole of the accounts of the northern seas require to be read with caution, and received with considerable allowances, as many of the describers of their productions appear to have caught no small portion of the romancing and fabulous spirit, for which the natives of these wild regions have, in all ages, been celebrated.

The general shape of the body when viewed laterally is, as has been mentioned, an elongated oval; the upper part is grey, with deeper spots, which vary considerably in size and number in different individuals, and the under part is of a pure and intense white, which is indeed the prevailing colour of the under part of all the cetacea which are inhabitants of the cold seas in high latitudes; and there is no doubt that this white colour tends much to protect the viscera and other working structures of these animals, from the intense cold to which they are exposed among floating ice and ice-water.



Greenland whale.

To appearance, there is hardly any distinction between the body and head of this animal, further than a slight depression immediately in the rear of the blow-hole, which may be considered as the neck. The blow-hole is crescent-shaped; the forehead low; and the snout obtuse and rounded. The mouth is very small in comparison with the size of the animal, and would not admit a body of more than between three and four inches in diameter.

The swimming paws are about a foot long, and eight inches in breadth; and, as is the case in all the order, they are much flattened, and their motions are in the cartilage, by which bone is united to bone, rather than in the one bone sliding upon the other, as in the joints of land animals. The dorsal ridge commences immediately in rear of the blow-hole, and continues all the way to the tail, only it becomes lower as it approaches that organ. The tail itself is formed into two lobes, which incline away from the body; and though it is horizontal, and therefore has its most powerful action in striking the water upwards and downwards, yet it has considerable twisting motion, and is a very efficient swimming instrument. The skin of the common narwhal is thin, and the blubber, or fat in the cellular tissue, only in small quantity; but in quality it is said to be much superior to that of any of the other whales, yielding, by simple expression, an oil which is said to be superior to that obtained from even the hard fat of the spermaceti whales.

The most singular part of this animal is the tooth, or, as it is sometimes called, the horn. It is deeply inserted in the bones of the skull, generally to the depth of at least a foot in moderately-sized specimens. This part of it is hollow, and filled with a sentient cone, the hollow terminating about the point at which it issues from the head. From this point it tapers gradually, and comes to a fine but in general not a very sharp point. In its direction it is not exactly parallel to the axis or general line of the body, but inclines toward that side in which it has its origin, which is sometimes the right and sometimes the left. When there are two of these teeth, they generally spread so much, that their fronts are about a foot and a half asunder; and even when there is only one, which is the general case, that one deviates about nine or ten inches from the mesial plane at its point. When there are two of these teeth, the distance of their bases at the snout of the animal is not more than about two inches.

The substance of these teeth is ivory, and ivory of a more compact texture than that of the teeth of the elephant, though it is perhaps more brittle. It is not, however, so liable to turn yellow as that kind of ivory, and is perhaps, on the whole, the more beautiful substance of the two.

Notwithstanding the powerful weapon with which it is furnished, the narwhal appears to be a very inoffensive animal, and even kind and gentle. It has been sometimes said that it attacks the whale, and gores it with this formidable horn; but the probability is, that the narwhal has, in these instances, been mistaken for the sword fish, which, though belonging to a different class of animals, is much more predatory and voracious than the narwhal. Indeed, if we except the whalebone whales, the narwhal is perhaps the least offensive of all the large inhabitants of the sea. These animals are usually found in the bays or open places of the northern ice; and, when they are annoyed there, they huddle together till they are apt to injure each other with their tusks; but even then they offer no violence to any other creature.

But they are of considerable value to man. The oil is, as we have said, of very fine quality, and the people of the northern countries are very fond of the flesh, and also of the intestines. They use the horn, or tooth, as timber, for which purpose it is well adapted, being both strong and beautiful. The king of Denmark is said to have a beautiful throne wholly composed of this material, which is carefully preserved in the castle of Rosenburgh; and in this country the large teeth are sometimes used as bed-posts, and the smaller ones as walking-sticks, for which, though rather heavy, they are not otherwise ill adapted.

Monodon microcephalus. The head of this species is, as the name implies, smaller than that of the other. It is of about the same length, or sometimes longer, being met with as much as twenty-six feet long, though it is found in smaller sizes, and sometimes not exceeding twelve feet. Its body is narrower than that of the common narwhal; and the ridge on its back is not so prominent. The upper part is also darker in the general colour, which renders the spots upon it less apparent. The spots on the sides are much more apparent than those on the back, and the belly is pure white. The skin is smooth and glossy, very thin, and firmly united to the adipose tissue. The mouth of this species is very small, the upper lip extending a little beyond the lower. The eye is far back, just immediately under the blow-hole; it is about an inch in diameter, and has the iris of a chestnut colour.

This species appears to be much more discursive in its habits than the common narwhal, having been found, not only on the coasts of the northern islands, Shetland in particular, but also, at least in one instance, upon the coast of England, near Boston in Lincolnshire. The individuals which come so far to the south must, however, be considered as stragglers; and though they are more frequent on the coast of Shetland than on any place farther to the south, they are only occasional visitants even there. It is probable that this species, on some of its southerly excursions, has been mistaken for the common narwhal, an animal which does not appear ever to have been seen out of its polar haunts, though in these it is no means rare.

The Anarnak (*Anarnacus Grœnlandicus*). This species, of which the history is very obscure, is unquestionably entitled to rank as a distinct genus, and not as a "spurious narwhal," as it has sometimes been called.

This species, like the former, is an inhabitant of the Greenland seas; but, according to the accounts, it keeps much more at sea than they do, and is, in consequence, much less frequently seen. It is also an animal of much less interest to the Greenlanders and other natives of the extreme north. It is but of small size, perhaps the smallest of all the cetacea; and, as one might infer from its seaward habits. it contains but little fat. Pelagic, or wide-sea animals, whether mammalia or fishes, are generally very fast swimmers, have their flesh firm and rather dry, and seldom have much fat upon them; and the anarnak does not form an exception to this general rule. Besides, it has been mentioned that the flesh of this animal has a cathartic or purgative quality, which renders it unwholesome for food; and there is no part of it to compensate the fishermen for the trouble of capturing it, which is considerable, as it drives about in the open water, and cannot be driven into bays, as is the case with the narwhals.

This animal is of nearly the same shape as the others, but its colour is black, and it has a fin on the back. The teeth are also very different, though they belong to the same class as the narwhals. They project from the snout, as in these species, and consequently are of no use either in the capture or killing of its food. They are very short and curved, and though the small portion that there is of them is compact ivory, they answer none of the purposes to which the teeth of the narwhals are applied. Their length is only about an inch, while the tooth of the narwhal is often six feet or more. Of these teeth there are generally two, as they are not subject to the same casualties as the longer teeth of the narwhals, though there are instances in which only one tooth appears. The mouth is small, as in the other species; and, as it contains no teeth or grinding apparatus of any kind, the animal must swallow entire all those creatures upon which it feeds. The teeth of all sea animals are, indeed, only prehensile or wounding teeth, and never answer for mastication; even the teeth of sharks, which have a motion upon the jaw, and by that means cut and tear at the same time that they hold, are not grinding teeth.

3. *With teeth in the lower jaw only* (*Subdentatæ*). The animals of this group are the true monsters of the deep. They attain a vast size, are very active, when irritated exceedingly ferocious; and they answer, in the water, to the lions and tigers upon land. They are not, like the balænæ, confined to the polar seas, or, like them, peaceful inhabitants of the waters; collecting small animals in a net, or, as one may say without much exaggeration, grazing the deep, for, though they do not eat vegetable matter, they eat only those substances which float near the surface. It is chiefly from the balænæ that we take our common notion of whales; and, therefore, we are apt to mistake the characters of those which form this group. On the other hand, it does not appear that the ancients had any knowledge of the Greenland whale, though probably specimens of the finned species may have been seen on the coast of Britain by the Romans when they circumnavigated the island. At that period, whales of some description or other appear to have been common much further to the south than

they are now to be met with; and it is certain that, at this time, there were very large specimens not unfrequently seen in the Mediterranean; and, as these are all described as toothed whales, there is no doubt of their being the spermaceti whales, which are now more abundantly found in the opposite hemisphere, where they form the principal subject of attraction in the south sea fishing.

These animals are the *Cachalots* or *spermaceti whales*, forming the genus *physeter* in the systems of zoology. As many as eight species or varieties are mentioned; but we must confine our brief notice to two or three of the principal ones.

The most remarkable character of these animals is the enormous size of their head, which is never less than equal to a third of the whole animal, and sometimes it is equal to a half. Much of the great mass is occupied by the upper jaw, which is excessively broad and deep, while the lower jaw is long and narrow, and so thin, as compared with the other, that it appears to apply to the rest of the head as if it were the lid of a box, only that it opens and shuts on the under side and not the upper. The upper jaw has no projecting teeth, but is covered with a very firm cartilaginous gum; but, in the body of this gum, a greater or smaller number of imperfectly developed teeth are usually found, though even their points do not reach the surface. In the lower jaw there are strong and thick teeth, of a conical form, usually rather blunt at the points, but formed of very strong and hard ivory, and therefore, when the size and motion of the jaw, and the immense volume of head against which it acts, are taken into the account, these teeth are very powerful weapons. The blow-holes are two in number, within the skull; but they open by one external orifice in the top of the head. Before them, and occupying a considerable portion of the snout, there is found the spermaceti, stearine, or crystallisable fat, on account of which the animal gets its common English name. As is the case with the whalebone whales, some of the species of this genus have a fin on the back, and others not; but those that have no fin have a dorsal protuberance, or rudiment of a fin, imbedded in the substance of the back. The substance known by the name of ambergris (or grey amber, which has no resemblance to amber properly so called,) is said to be chiefly found in the intestines of this genus of animals, or discharged by them, and floating in the sea, or cast upon the shores.

Physeter macrocephalus, the great-headed or great spermaceti whale, is one of the largest of the genus. It is found in the Greenland seas, but it is a much more ranging animal than the whalebone whales, and thus it is not unfrequently met with on different parts of the shores of Europe, specimens measuring upwards of sixty feet in length, and ten in diameter, have been met with; and they are perhaps the most shapeless of all mammalia, appearing on the water like the summit of a black rock of no inconsiderable dimensions. The head justifies the application of the term *macrocephalus*, or great-headed, for it occupies nearly half the length, and more than half the volume, of the animal when young. This head has the appearance of a great clumsy box, blunt and rounded at the fore part, and marked posteriorly by a slight elevation above the line of the neck. The eyes are very small in comparison with the size of the animal, and they are furnished with eyelids very much resembling those of the land mammalia. These eyes are very distant from the extremity of the snout, so much so that they are not very far from the middle of the length, exclusive of the tail fin. From their position, it is quite impossible for the animal to see before it in any way, and an object must be at a very considerable distance before it can be seen with both eyes in any position. The blow-hole, which is about six inches in diameter, is placed forwards, just above the end of the snout; and the external openings of the ears are so small as scarcely to be discernable. Indeed when the animal is in a state of repose upon the water, in which state it floats high, especially with the head, which is rendered specifically light by the vast accumulation of spermaceti,—this whale, seen at a little distance, has very little appearance of being a living creature at all. In the upper jaw, that is, in the hard cartilaginous gum with which the lower surface of this jaw is covered, there are holes answering to the teeth in the under jaw, which fit into those holes, so that the two hard gums can be made to bear firmly against each other; and, independently of the teeth, the animal can give the same sort of bite as is given by the horny jaws of the larger water tortoises, only the bite is more formidable in proportion as this whale is the larger animal of the two. The upper part of the body is dark, a sort of deep slate-colour, approaching to black, but having a tinge both of blue and of green. The under is white, and there are often white spots on the sides, and sometimes on the back. The tongue, which is large and square, is of a dull red colour. The swimming paws, and also the tail, are proportionally smaller than those of the whalebone whales, and the lobes of the tail are long and pointed. This organ does not form nearly so powerful a weapon as the tail of the great whalebone whale; but the action of the rest of the body of the animal is much more energetic; and it dashes along the water with great velocity, appearing to ride very light and buoyant, compared with many others of the race. From the size its weight must be enormous, and its gambols in the water make much agitation, and render the approach to it in a boat a matter of much hazard. Still, even the Greenlanders, simple as are their weapons and other instruments, attack this formidable animal with great readiness, and esteem it one of the greatest prizes which the sea affords. The capture of it is altogether a much more hazardous matter than that of the whalebone whale; but from the superiority of spermaceti to the blubber fat of the other, it is a much more valuable prize. The greatest accumulation of fatty matter is in the head of this animal; for the blubber or accumulation in the adipose tissue over the general surface of the body, is small in quantity and inferior in quality, consisting in great part of membrane. On the back, where it is thickest, it does not exceed five or six inches, while on the belly it is less than this.

The Greenlanders however turn it to great account. The tongue, which is of a very large size, is one of their dainties; and they also eat the flesh, the skin and the intestines, the first of which is pale coloured, not unlike pork in appearance, and, in young specimens, said to be not much inferior. The bones are used as timber, and partially also in the manufacture of weapons and smaller articles.

Physeter Trumpo. This is the blunt-headed spermaceti whale, one of the largest of the species, and a very valuable one; but it is even more daring than the species last mentioned; and it is also more excursive. It is found of nearly the same length with the other; but the body is rather more slender, while on the other hand the head is thicker, especially towards the snout, which is rounded, projects about five feet beyond the lower jaw, and measures at least eight feet in depth, from the crown to the opening of the mouth. The lower jaw is about ten feet long in the opening, which makes the bottom of the gape fifteen feet behind the extremity of the snout. This thick and projecting portion of the snout consists for the greater part of spermaceti; and the fat upon the body is more abundant than that on the great-headed species, and also of superior quality. When we speak of great-headed as applied to these animals, the term is by no means accurately descriptive, for the species now under notice has really the greater head of the two, although the thickness and bluntness of the snout form a distinction. The lower jaw, the depth of which bears but a small proportion to that of the upper, fits into a sort of groove in the upper one. It has about eighteen teeth on each side, which have their points turned outwards; and the two hard gums close with oblique edges, so as to crush or hold with great force. This animal is very bold, attacking its enemies with great determination, so that it is very dangerous to come near it if wounded, and not mortally.

Physeter microps. This is the small-eyed spermaceti whale; and though there is necessarily a good deal of confusion in the accounts of animals which are generally attempted to be killed the moment they are seen, and which cannot be very well or very closely examined alive, yet this seems to be the most active and also the fiercest of the whole genus.

This species which is found both in the cold and the warm seas, and which has been occasionally stranded on the west coast of Europe and on the British shores, is generally understood to be the great sea-monster of the ancients; the one from the peril of which Perseus delivered the fair Andromeda, and for which act the whole three have had a place assigned them among the constellations. It is also the one against which, according to Pliny, the Emperor Claudian mustered his army in the port of Ostia, and probably also the one alluded to in the prophecy of Jonah, although the description there must be considered figurative, as no doubt the others are in great part at least fabulous.

This has some resemblance to the species already noticed, but it differs from them in many particulars. Its colour on the upper part is blacker, indeed almost entirely black; it has a dorsal fin, which is straight, high, and pointed; its eyes are very small, and though its head is very large it is not quite so much so at the muzzle as that of the blunt-headed. The swimming paws and the tail are larger than in the others; and the body is rather more slender. There is not nearly the same tendency to accumulate soft fat on the body as in the whalebone whales, or even in the other species of this genus; but the quantity of spermaceti is great, and its quality is excellent.

The mouth of this animal is very formidable; the upper jaw does not extend wholly to the extremity of the snout, but it is a little longer than the lower jaw, and the two close upon each other more firmly perhaps than in the blunt-nosed species. The teeth in the lower jaw are about forty-two in number; they have hollow roots resembling the tusks of elephants, and of the narwhals much more than they do common teeth. They do this both in their structure and in their texture; and this structure is common to the teeth of cetaceous animals, whether those teeth be in the one jaw, in the other, in both, or projecting from the snout, unconnected with the opening of the mouth as they do with the narwhal. These teeth have their hollow bases inserted in the gum for about two-thirds of their entire length. The portion which stands above the gum is white like ivory, conical in its general form, and sharp at the tip, but bent first backwards and then a little outwards. They are, in short, very dangerous teeth to come in contact with, and the animal has great power in its jaws. As is the case in the species formerly described, these teeth lock into corresponding holes in the hard gum of the upper jaw; but though they appear but little above the surface of the gum, there are teeth also in all the intermediate parts of this jaw, so that this whale may be said to begin its bite with the teeth of the lower jaw, and finish it with those of the upper.

This species is described as being much more ferocious than the former, though hardly equal to them in size. The peculiar formation of its mouth enables it to bite in pieces, though not to grind or masticate, and therefore it ventures to attack much larger prey. It masters not only the largest species of fish, but also many of the animals of this family. Dolphins, porpoises, and even the larger dolphins which sometimes attack the whalebone whales, are among the every day prey of this indiscriminate devourer. Nor does it confine itself to these, it attacks the balænoptera even when they are full grown, and the young of the great whalebone whale itself.

By the fishermen, all the species or varieties of physeter which have been enumerated, together with five or six more which are not so well defined, are classed under the general name spermaceti whales. They are probably all found in one place or other of the Greenland seas, or northern parts of the Atlantic; but that is not the district where they are found in the greatest numbers, or captured to the greatest advantage. The Pacific is their grand field, and their range along that great ocean from Behring's Straits to the Antarctic ice. They are also found, seasonally at least, in the Indian Ocean, and they are very common upon some parts of the shores of Australia. They are very interesting animals, and highly valuable in a commercial point of view; and as the Pacific is a very wide pasture, and from their indiscriminate feeding they have a much wider range than the more peaceful whales of the north, there is less danger of thinning, or, at all events, of exhausting their numbers, than there is in the case of these.

4. *With produced teeth in both jaws* (*Ambidentatæ*). The cetacea which have regular teeth in both jaws are of much smaller dimensions, more numerous, some of them at least better known, and all of them more easily examined than those more gigantic species which form the third group in our enumeration. They are usually arranged into two genera, *Delphinus* (dolphins and porpoises) and *Hyperöodon* (beaked whale). There are several species of the former genus, but only one of the latter, and there is some confusion in the history even of that one.

Dolphin (*Delphinus*). Scarcely any specimen of this genus has been met with exceeding five-and-twenty feet in length. They must not be confounded with the dolphin of the ancients, and what is still called the dolphin by the Dutch and some other nations. It is a true fish (the coryphene) and not a warm-blooded animal as the real dolphins are. It is probable that the ancients did not always mean the coryphene when they spake of the dolphin, though that fish was certainly the dolphin of the Mediterranean—*Arion's dolphin.* But when Juvenal, in his tenth Satire, makes use of the simile of the dolphin and the whale, in a sense not very dissimilar to that of the fable of the frog and the ox, it is possible that he may have meant the warm-blooded dolphin: "Quanto delphinus balæna Brittanica major."

The dolphins have not the enormous head which is characteristic of the whales; and on that account they are more shapely animals. Their jaws are lengthened, and both are furnished with conical teeth, placed in an even row, but varying in number with the species. The blow-holes pass the upper jaw in two separate apertures, but the openings are conjoined into one externally, which is on the top of the head, and of a crescent shape. The eyes are placed near the angle of the mouth. All the species have dorsal fins, with the exception of one, and these fins are often of vast length, appearing like the sail of a boat as the animals swim, or rather tumble along through the water; for their march, which is much more rapid than it seems, is made by a series of leaps, at the middle of each of which the fin, and indeed the greater part of the body, is seen above the water, while, at the beginning and end of the leap, the whole disappears.

This is the mode of swimming in all the cetacea; and it is easy to see, from the formation of the tail, the most powerful organ of motion in them all, that this must be the case. Their action, like that of land mammalia, is in the vertical plane, while the most powerful action of fishes is in the horizontal. Their tails strike upward and downward, and those of fishes strike laterally; the resistance to the stroke upwards is less than to the stroke downwards, because the pressure of the water increases with the depth; and thus when the cetaceous animals make great exertions in swimming, they always to a considerable extent work themselves up to the surface. This agrees with their economy as animals that breathe the free air; as it gives them the opportunity of breathing at the top of each of their leaps, without any other muscular exertion than that which is required for their progressive motion through the water. We know by experience that the respiration of all animals requires to be increased in the proportion of the exertion which they make; and it is a beautiful instance of adaptation to find that those air-breathing animals, which find their food in and generally inhabit the water, come naturally upon that element in which they breathe, whenever greater exertion renders more frequent respiration necessary.

Fishes again, which breathe water, have no tendency from the mere action of swimming either to rise or to descend, their tails strike the water right and left, and of course they strike against exactly an equal pressure both ways; and thus, when they either rise or descend in the course of their progress, they do it by an additional effort, and they are fatigued by it, and also have their peculiar kind of respiration impeded rather than assisted by it.

This can be very well observed of the common porpoise and the salmon, in the estuaries of the salmon rivers. The porpoise is very fond of salmon, and pursues them with great assiduity as they ascend the rivers. This is best seen, when it clears up after a heavy summer rain, which has brought a good deal of "fresh" into the estuary. The salmon always swim upon the "fresh," whether on account of its being there an additional supply of food, or for some other physiological cause, is not very clearly known; but any one who has paid any attention to the habits of salmon must be aware of the fact.

The salmon hold on their straight course, not far from the surface, for, as we have said, they swim upon, that is, they swim to meet the fresh; but while they are able to keep at a safe distance from the pursuing enemy, they do not appear above water. The porpoises tumble along, in the manner above described, not only showing the fin, but, in their eagerness to catch their prey, springing partly, or even altogether, out of the water. This is, by the way, far from the worst time for striking porpoises with the harpoon, or even with the spear, if they are very eager in the chase, and they generally are so, and also not singly, but in packs.

At length the salmon begin to get fatigued and exhausted; for there is nothing to renovate them in the same way that the ascent to the air renovates the porpoises; and when they are all but in the formidable jaws of the enemy, they leap into the air; but that is a means of fatigue to them, and not of relief: it is only another tumble forward on the part of the porpoise, and the salmon falls exhausted into its mouth. If both animals are in numbers, on a summer evening, when the sun is low, and the sky has just cleared of the rain, this chase is a very beautiful sight. The scales of the salmon show prismatic colours, and, as their leaps are taken with great rapidity, they seem as if they were little rainbows, rising momentarily out of the water. We shall now notice a few of the leading species of dolphins.

Delphinus phocœna (the common porpoise). This species, the common name of which in most European languages means "sea-hog," is the most abundant and the best known. It is plentiful in all the European seas, and especially so upon the coast of North America. Though a thick and apparently unwieldy animal, it is exceedingly active in the water, and even playful, frisking and even gamboling about, as if fond of amusement. There is a good deal of "speculation" in its eye, as compared with the eyes of fishes; and it shows an attachment to its kind, of which there is no known instance among the cold-blooded inhabitants of the deep. Many of the fishes assemble in shoals, but there does not appear to be any principle of society among them; and there are at least many of the species, in which the large ones prey on the little as readily as on any other kind of food; but it does not appear that any of the cetacea are cannibals; and the porpoises certainly imagine each other as members of the same society.

They accompany all the smaller species of shoaling fish upon their migrations; and where these are abundant, the porpoises often appear in very numerous packs, darkening the surface of the sea as they display their fins, and the upper parts of their bodies. When they are more playful than common, the sailors usually regard it as a sign of bad weather; and it is probable that they are correct. The storm at sea is a time of want for many of the fishes, more especially those that find their food near the surface; and we may suppose that, according to the general law of nature, that there should be a natural provision against the period of natural want, corresponding in some degree to the continuance and severity of that period. Nor is there any doubt that at those times, when the porpoises gambol much at the surface of the water, the surface fishes are generally near the top, the water being then quiet and transparent, and also considerably affected by the diminished pressure of the atmosphere which usually precedes storms, as is indicated by the fall of the barometer.

The common porpoise is generally about six or seven feet long, very thick in the fore part of the body, and tapering gradually towards the tail. The upper part is bluish-black, or sometimes very dark brown, and the under part whitish, but not bright in the colour. The muzzle is short and broad, though the snout does project a little beyond the opening of the mouth. Each jaw contains about forty-eight teeth, which are small, sharp-pointed, and slightly moveable on the gum. The tongue is flat, zigzag on the sides, and united below to the under part of the mouth. The eyes are small for the size of the animal, though not nearly so much so as in the whales, especially the spermaceti whales.

When the porpoise is in good condition, the blubber of it is very thick, and furnishes a considerable quantity of very good oil; a large sized one yielding as much as a hogshead. The flesh is also tolerably well tasted; and in former times, when dishes were prized for their size, the porpoise was a leading dish at feasts. It is still eaten in some parts of the world, though we believe that our English epicures do not now have porpoise, and porpoise-sauce made of crumbs of bread and sugar, in the list of their dainties. Indeed the animal is far from being a favourite even with the fishermen, who look on it as a formidable rival in their trade, alleging that it drives the fish off the coasts, and injures their quality by hunting them about, as well as thins their numbers. It is also very apt to break and otherwise injure their nets.

It is generally understood that it does not, at least at all seasons of the year, confine its labours to surface fishing; but that it descends at least into the shallows, and not only captures flounders and other species which inhabit near the bottom, but even ploughs up the sand and mud with its snout, in order to capture those species of fish which burrow in these shallows. This is not improbable, as it is generally understood that even the salmon catch eels something in this way.

The skin of the porpoise, when properly dressed, makes neat, and very compact and durable leather, only the inner or fleshy side of it has to be much curried down, in order to remove all the cellular tissue. There are many anecdotes told of the modes of capturing these animals, especially on the American coast, where they are much more abundant than on that of Europe. We may quote one of these as throwing some light on the character of the animals. "The inhabitants of Canada, about the river St. Lawrence, adopt an amusing method of taking porpoises. They collect together a considerable number of slender branches of sallows, willows, or similar trees, and stick them firmly into the sand banks across the banks of the river, which are commonly left dry at low water, so as to form a long line of twigs, having the upper end connected with the shore, and an opening left next the sea, by which the porpoises may enter. As the tide rises the water covers the twigs, so as to keep them out of sight, and the porpoises, entering the river in quest of their prey, get within the line, where they continue the chace till they find, by the ebbing of the tide, that it is time to retreat into deep water. They now make towards the sea, but then the twigs coming into sight, and being all agitated by the current of the tide, form such an alarming spectacle, that they retire in great fright from this tremendous rampart. The tide continuing to ebb, the porpoises return from time to time, but not being able to conquer their dread of those terrific twigs, they flounder about till they are entirely deserted by the tide, when the inhabitants, watching a favourable opportunity, commence the attack, and soon overpower the defenceless animals. In this manner more than one hundred porpoises, each yielding about a hogshead of oil, are sometimes taken at a single tide."

Delphinus Delphis—the common dolphin. This species is considerably longer than the last mentioned, but it is not nearly so thick in proportion. The usual length is about nine or ten feet; the nose long, narrow, and pointed, with a transverse furrow across the skin towards the upper part; though there are none of the characters usually given to the imaginary dolphin of painters. The gape is very deep, reaching nearly to the articulation of the head; and the teeth, though variable in number, are said usually to be about forty in the upper jaw, and thirty-six or thirty-eight in the lower. The dolphin is more an inhabitant of the wide seas than the porpoise, and it is also found in lower latitudes, often accompanying ships for a long way on their passage to the East and West Indies, but is of rare occurrence on the British shores, and appearing there only as a straggler. The dorsal fin is even higher than that of the porpoise; and as the upper part is blacker, and the under part much whiter than in that animal, it makes a much more conspicuous figure in the water.

It is much more discursive than the porpoise; but still it is like that a gregarious animal, and very sportive, leaping entirely out of the water, with the back sometimes a very little arched, and the tail a little curved, during their leaps, but nothing at all as compared with the fanciful representations. It must be borne in mind, that, as the principal action of cetaceous animals is in the vertical plane, while that of fishes is in the horizontal, we might expect some flexure either upwards or downwards, in the posterior part of the spine, just as we find lateral flexure toward either side in the spines of fishes. There is, however, an optical deception in the case of an animal leaping from the water, and falling down again, which makes one imagine its back to be much more curved than it really is. Thus, when even a salmon leaps, it seems bent so far like a bow; and yet we know that the spine of a salmon bends little at all, either upwards or downwards. The cause of the deception is in the eye following the general curve in which the average mass of the body is carried, during the leap; and as the real shape is not very well seen while the animal is in motion, it is readily, and indeed necessarily, associated with this curve.

As might be expected from its more discursive habits, the flesh of the dolphin is inferior to that of the porpoise. Formerly, it was more highly prized than that animal, probably on the account of its greater rarity; but now it is not sought as food, or considered valuable for any purpose to range the sea without molestation. It is a voracious animal, and will feed upon any garbage which is thrown overboard by the crews of ships, and it is probable that this kind of food is its chief inducement for following them; but it does not appear that this species attacks any sort of prey but fish, though it has sometimes been said that it assails the whalebone whales.

The common dolphin is of little or no value as an oil animal, as the seas which it inhabits supply it with abundance of food at all seasons, while the width of its range, and its being pelagic, rather than a frequenter of the bays and banks, keep it thin, from being constantly in exercise.

Delphinus orca (the Grampus) is one of the largest and most powerful of the genus. It attains the length of twenty-five feet, and when it does so, it measures not less than twelve in circumference, and its dorsal fin is at least five feet in height. The upper part is black, the under white, the sides mottled, and there is generally a white spot upon each shoulder. The lower jaw is broader than the upper, and each of them is furnished with about thirty teeth; three are in the front part of the mouth, slender and blunt in the fronts, but farther in the gape they are larger and conical, with sharp points. The grampus is found in most seas,—the Atlantic in almost every latitude, the Mediterranean, and even on the coasts of Britain, though it is rare. There appear to be several varieties, at least in so far as the colours and the height of the dorsal fin are concerned; but their habits appear to be all very much alike. They are very active and voracious animals, preying not only upon fish, but upon seals, porpoises, and dolphins, though it does not appear that they, as is sometimes alleged, attack and bite the Greenland whales.

In their general habit they are pelagic animals, and seldom remain for any length of time on the surface; and this habit is sometimes the cause of stranding to them, as, when they come into the shallows, they are apt to get grounded. When attacked, they make a powerful resistance. The females are much attached to their young, and can hardly be made to abandon them even by personal danger. The great activity and strength of the grampus, and the perfect uselessness of its carcass after it has been killed, cause it to be little sought after. Even when it gets stranded, the labour of putting it to death is considerable, and all that is got for the labour is a great mass of flesh, which speedily becomes putrid, and renders the place where it lies unpleasant and unwholesome. It does not appear that much fat is ever accumulated upon these animals.

Delphinus gladiator (the gladiator dolphin, or sea-sword) is another large species, rivalling the grampus in length, but not quite so thick in the body. It gets the name of sea-sword from the shape of the dorsal fin, which is about five feet long, one foot and a half in breadth at the base, and tapering to the front. The upper part of the body is blackish-brown, the under pure white, and there is a black stripe on the side extending from the tail to near the articulation of the swimming paces.

It differs from all the varieties of the grampus, in having the snout much rounded, all the teeth strong and sharp-pointed, the jaws of the same length with each other, and the dorsal fin situated much farther forward.

This is an animal of great boldness and strength. Like the rest of the genus, it is gregarious, at least to a certain degree; and though we must not implicitly credit all the marvellous stories which are told of it, yet it is possible that several of them may make a joint attack on a Greenland whale. The tongue of that large animal is said to be the part at which they aim; and there is little doubt, that if one once gets a hold, others will endeavour to follow the example.

They are said not to be so fond of meddling with the full-grown whales; but the pack will readily attack a young one, bite it in various parts, and even catch it by the lobes of the tail. If they can once fasten in this part, which, from its length and fibrous texture, gives them a very firm hold, the power of the whale is at an end, as it cannot shake off the enemy, which hangs as staunchly by this part as a bull-dog does by the nose of a bull, or a lion by the muzzle of a buffalo. The others then bite with impunity, till they throw their victim into an agony of pain; and when it lolls out its tongue, which it does when severely hurt, the others are on the alert to seize that organ.

Instances have been mentioned of these animals carrying off, in the Greenland seas, the entire carcass of a whale, which several boats were in the act of towing, and that, in spite of all the efforts of the rowers, they bore it off in triumph.

This powerful animal is chiefly found in the north-west parts of the Atlantic, near the whale-fishing ground in Davis' Straits, but it occasionally ranges farther to the south; although it does not appear to be nearly so discursive in its habits as the grampus.

In the year 1793, one gave a specimen of its strength in the water in the Thames. This is not the only individual that has come into that river; but it was attacked by four men in a boat, and struck with three harpoons, and made fast. Still it drew the boat with the four men twice from Blackwall to Greenwich, and once as far up the river as Deptford; and, as this one was astray, out of its natural beat, we may naturally suppose that it was exhausted, and not so powerful as it would have been in its native seas.

Hyperöodon. There is only one species of this genus, the beaked whale, or bottle-head (*Hyperöodon*, Butskopf), which, in the structure of its teeth, is the most peculiar of all the marine cetacea. It is most abundant in the cold latitudes, but has been met with occasionally in many parts of the North Atlantic and North Sea. It is about twenty-four feet long, and fifteen in circumference at the thickest part, which is at the articulation of the swimming paws. The body thence to the tail has the form of a cone, and the lobes of the tail, which are concave at their margins, measure about six feet from tip to tip. The general colour is a deep blackish-brown, relieved by paler streaks and blotches on the under part. The depth and length of the head are nearly the same, but the mouth is lengthened out in the form of a sort of beak. In the lower jaw there are only two teeth, situated on the anterior part, conical and pointed; but the upper jaw and palate are beset with small sharp teeth, which vary considerably in size. The jaws are nearly of equal length; the tongue adheres to the lower jaw, and is toothed on the margins. The blow-hole externally is single, and crescent-shaped, with the cresses directed to the rear. The eye is placed over the corner of the mouth, and appears nearly in the middle of the head. The skin is very thin, the blubber yellowish, and the flesh of a much darker red than that of almost any others of the order.

Such are a few points in the outline of some of the leading species of this very remarkable order of animals, at least of those which are inhabitants of the sea. They vary in their modes and means of feeding, but they must all be considered as animal feeders; for, though the whalebone whale neither does, nor can bite any animal, but lives by filtering the water through the fringes of its plates of whalebone, yet the substances which it procures by this filtering are animal, not vegetable; and, though that portion of the sea in which it is chiefly found is technically called the "green water," yet the greenness arises from animal matter, not from vegetable. There still remains one subdivision or group of the order which are wholly or chiefly vegetable feeders. They are inhabitants of the warmer parts of the world, and are found in the rivers and their estuaries rather than in the ocean.

Herbivorous Cetacea. These differ much from the carnivorous cetacea both in their appearance and in their habits. Their teeth are flat on the crowns, and adapted for dividing and bruising vegetable substances; and some of them often quit the rivers to crawl about and graze on the banks. They have hairs in the form of mustachios, and the females have two pectoral mammæ. Hence, as Cuvier very justly remarks, they may have given occasion to the ancient fables of tritons and sirens, and also to the modern one of mermaids, though the mermaids of the Scotch, and of the rest of the north of Europe, to which these herbivorous cetacea very seldom, if ever, come, have most probably been albino seals, unfortunates which the rest of these wily animals are said to drive from the common society, and compel to sit solitary among the rocks.

In their general characters, these animals appear to be intermediate, between the cetacea of the ocean and the seals, though they partake more of the general characters, especially of the structural and physiological ones, of the former. They have the stomach divided into four separate sacs, of which two are lateral, and the intestine is furnished with a very large cæcum. The breathing holes are perforated in the upper part of the skull, as in the other cetacea, but they are continued in the soft parts to the termination of the muzzle. The lips are thick, the upper one usually divided in front, enlarged at the sides, and beset with bristly hairs. The external openings of the ears are very small, and concealed by the epidermis; the eyes are also small, but have the expression of those of land animals. The swimming parts are larger and rather more developed than those of the marine cetacea. The fingers are larger, though they are included for their whole length in the membranes, and some of them at least terminate in rudimental nails. They are rather ungainly walking apparatus, but they still enable the animals to make a sort of progressive motion along the banks, to which they resort to traverse the herbage.

The posterior termination of their bodies is a tail, as in the cetacea, and not the union of a tail and two imperfectly formed swimming paws, as in the seals; but in some of the species at least there are rudiments of the bones of a pelvis imbedded in the flesh of the flanks; and, imperfectly developed as these bones are, they no doubt assist the animals in maintaining their vertical position—that is, preventing them from rolling over on the side as they attempt to advance the swimming paw, as is the case with the whales and dolphins.

There are several species, the history of some of which is not, however, very clearly made out. They have been hitherto found only in the waters of the warmer latitudes; and those of the Atlantic, and of the Indian and Pacific Oceans, are described as different genera. When we say of the oceans, we principally mean the shores, and estuaries of rivers emptying themselves into the oceans; because we are not to expect that any vegetable-feeding animal can be pelagic, and keep out in the open sea. As there are, however, many fishes and some reptiles—turtle, for instance—which live in great part upon the vegetable productions of the tropical seas, it is by no means unlikely that animals of this group may do the same.

So far as these animals are known, they are all very wild in their dispositions, and their flesh is much better flavoured, and more eagerly sought after as food, than that of any of the other cetacea.

The Manati (*Manatus*, Cuvier). By the older naturalists this animal was very incorrectly classed with the mouse (*Trichechus*), which belongs to the seal family, and has not the structure of the habits of the cetacea. The name *Manati* is said to have been given to the animal on account of the slight hand-like form of the swimming paws, and has been somewhat strangely metamorphosed into *lamantine*, by the incorporation of the article *la* with the original name.

These animals have been found only in the great rivers of South America and of Africa, which discharge their waters into the Atlantic within the tropics; the Amazon and its branches especially on the American side, and the Senegal and Gambia on the African. In the Niger, and its continuation to the bight of Benin, and the Quorra, these animals are not known to any great extent, but it is most likely that they may also be found there, and probably in the river of Congo, though the current of that may be too rapid, and its banks too steep and rugged for animals whose powers of motion upon land are so limited. Those which are found in the African rivers are described as differing from the American ones, so that there may perhaps be two species, *Americanus* and *Africanus*, and probably varieties of one or of both. At present, however, our information, especially as respects those of Africa, is rather vague.

In America, on the other hand, they are well known; and along the whole valley of the Amazon, up almost to the mountains, their flesh forms a considerable part of the food of the people.

The characters of the manati are: the body oblong when seen on the side; the tail fin oval and rather elongated; the grinders eight, with square flat crowns, marked with transverse ridges; but the adult animals have neither incisive nor canine teeth. The young are said, however, to have two sharp and pointed teeth in the intermaxillary bones, but these disappear at a very early age. The paws have the rudimental nails which have been mentioned, but they are seldom complete on all the fingers; still they give some support to the termination of the paws.

These animals are locally known by the name of *vacca marina*, or sea-cow, and certainly they form in many respects the nearest approach to the genus *bos*, which is to be met with among animals frequenting the water. Among the native mammalia of South America they are the ones whose flesh is most abundant in quality, and also most palatable for human food, and for these reasons they are the most valuable to man.

In the course of the present work we have frequently had to remark upon the very peculiar characters of this part of the world—in particular, that many parts, especially of the great tropical valleys, are alternately parched land and fresh-water sea. Such a state of things is perfectly inconsistent with the existence of browsing animals—with the ruminantia, which are found in most other parts of the world. It is, as it were, the extreme of vegetable feeding, where not only the semi-aquatic buffalo, but even the hippopotamus, must give way, as they would be subject to starvation at one season, and to drowning at another; for, when the rains come, there is too great a breadth of the country laid under water for allowing any animal which walks the bottom to subsist. This is farther increased by the quantities of weed and sludge, in which the feet of a walking animal would stick beyond the possibility of extrication.

We have this partially in the tropical parts of Asia and of Africa, but nowhere to the same extent as in South America. We have, accordingly, herbivorous cetacea in those places, but they are nowhere so numerous, or so exclusively the herbivorous animals of the valleys, as in the case of South America, where the principal grazing animal is committed to the water as its general habitation, and its means of transport from place to place. The power of swimming which these animals possess not only renders them quite safe from those casualties to which ruminant animals would be subjected when the rains and inundations come, but it gives them a facility and a range in their migrations in quest of food which not even the fleetest of the antelopes, or any of the mammalia which walk upon the earth, can possess. These last are hemmed in by the mountain ridges, by the deserts, and even by the larger rivers, and their march is laborious, and their food often scanty. The manati, on the other hand, launched upon the water, buoyant, and at home in that element, can, without any fatigue, migrate for thousands of miles whenever such migrations become necessary. In these extended marches they are not restrained even by the sea; for although, as we have already said, it is not very probable that vegetable feeders shall range the breadth of the ocean, yet it is certain that these animals often pass along the shores to very considerable distances.

They also have this advantage, that they are far more certain of provision by the way than the walking animals which migrate on land. In tropical countries there is never any barrenness if there is water, whether that water be a lake, a stream, or the sea; and thus the animals in question can always approach the bank, and feed whenever a supply is required.

When full grown, in places which are favourable for them, these animals are very large, generally more than fifteen feet in length, and sometimes twenty or upwards. They are gregarious, and often found in numerous herds, especially on the low meadows by the banks of the Amazon, where the soil is humid and the vegetation rich. They are gentle in their dispositions, and it does not appear that they offer violence to any creature; and when they are threatened with danger they move off for the water. The females have generally two at a birth, and the period of gestation is said to be about twelve months. The largest of these animals, that is to say, those which are about twenty feet in length, weigh between three and four tons; the swimming paws are rather less than a fourth of the whole length from the point of the muzzle; the skin is of a deep blackish grey colour, slightly granulated on its surface, and having a few scattered hairs here and there, though very few, with the exception of those which form the mustachios.

The manati of Africa is smaller than that of America, being seldom more than about eight feet long and seventy or eighty pounds in weight. Its colour is blackish ash, with the iris of the eye blueish. The bones of the head are said to be shorter in proportion to the length of the animal, and the different parts are said to be more marked. The differences are, however, comparatively small, and the habits of both are nearly the same.

The Dugong (*Halcione*—daughter of the sea). This is much more a marine animal than the manati; and though it ascends the larger rivers to some distance, it is chiefly found in the salt water, and its principal food is understood to be sea-weed. It is found chiefly on the south-east of Asia. The name "dugong" is said to be Malay, and to have much the same meaning in that language as "sea-cow." Illiger's generic name *Halicore*, of which "sea-lass" is perhaps the best English translation, is not very applicable; but the animal certainly claims to be made a distinct genus from the manati.

There are some differences in the skeletons, as for instance, the dugong has a pair of ribs more, a greater number of vertebræ in the tail; the rudimental pelvis rather more developed, and also the clavicles. The principal differences, however, occur in the teeth; the cheek teeth of the dugong consist of two cones united together, and with their tips flattened and formed into small tubercles, and the teeth in the fore part of the jaw do not perish early in life like those of the manati; they continue and become true tusks, firm and sharp-pointed, but concealed by the thick and fleshy upper lip. These lips are granulated in their appearance; the upper one projects so far over the lower as completely to cover the opening in front, and the extremity of it is, in part at least, prehensile. The whole animal is covered with a thick skin of a blueish grey colour, with spots of a darker tint on the flanks, and white spots on the belly. The muzzle is beset with hairs intermixed with horny spines, those on the lips being about an inch long. Those parts of the jaws with which it seizes the sea-weed and other plants on which it feeds are beset with horny tubercles; and it is probable that it also uses the tusks of the upper jaw in loosening the sea-weed from the rocks. The eyes are very small, and covered with a third eyelid; the ear-openings are exceedingly small, and the nostrils are on the tip of the muzzle, so that the animal can breathe freely with the whole of the feeding apparatus under water.

This animal is found in the greater part of the Indian ocean, and the south and west of the Pacific. Its head quarters may be considered the oriental archipelago; but it is understood to shift with the monsoons, being more abundant on the east of the

Limdel islands during the north-eastern monsoons than during the opposite one.

The Stellere (*Rytina*—wrinkled). This animal is found in much colder latitudes than any other of the herbivorous cetacea. Its chief habitat is the northern parts of the Pacific, where it occurs both on the coast of America and on that of Asia. The history of this animal was, for some time, obscure; but it is now tolerably well cleared up, and there is reason to believe that, in some parts of the north seas, stray specimens of this genus may have been the mermaids, of which the accounts are too numerous not to have had some foundation, however much of that which was raised on it may have been fabulous.

The most remarkable character of this animal is the teeth, of which there is, properly speaking, only one in each side of each jaw. These teeth are flat on their crowns, with many zig-zag ridges of enamel; but the intermediate matter, which forms the body of the tooth, is of a horny nature. They have no true roots, but are united to the jawbones by means of cartilage, in the same manner that the plates of baleen in whales are united to the bones of the head.

The head of the animal is obtuse, without any distinct appearance of neck; the body is thick at the middle part, but tapers off to the tail. The whole body is covered with a very thick epidermis, which is naked, or without detached hair; but it may be regarded as a coat of short hairs, all soldered into one compact mass, for it consists wholly of short fibres which stand perpendicular to the surface of the *epidermis*, or true skin. This structure of the epidermis is certainly curious, but it is in the structure merely that the curiosity consists; for, in all animals, the substance of the epidermis has a very considerable resemblance to that of hair, and, indeed, even hair and feathers are of the same nature as the epidermis, and, in fact, productions from it. The fingers of the swimming pores are closely united to their terminations by the membranes, and they have no distinct nails, though the tips of the pores are callous. The caudal fin is crescent-shaped, very broad, but not very long, and its two points are very sharp. The females have two mammæ on the breast, which are rather prominent.

The lips have the appearance of two great sausages; the mouth is small and below the muzzle; the eyes are, in great part, covered by a cartilaginous membrane, which forms a sort of third eye-lid; there are no external ears; and in the paws, the bones of the fingers are short and soldered together, so that this animal is not more powerful on land than the cetacea properly so called. Two of the vertebræ of the neck are so closely united, that some describers have stated them as being only six in number; but this is a mistake. There are nineteen vertebræ in the body and thirty-five in the tail. The rudimental bones of the pelvis are long and round, and attached to the tail vertebræ of the body by ligaments. The stomach is not so completely divided into compartments as in most of the other cetacea, but the intestines are very long; the cæca are large, and the colon is turned and partially divided by septa. The whole of the alimentary apparatus, indeed, indicates a very laborious digestion.

There is only one known species, an inhabitant exclusively of the sea, in which habit it differs from the rest of the group, more especially from the manati. The skin of the body is very rough and wrinkled, and was compared by Steller, the first person who observed and described the animal, to the rough bark of an old oak tree. The head is small as compared with the body; it is elongated, and diminishes down from the top to the muzzle. The mustachios are several inches in length, re-curved, and of a white colour. The nostrils are in the front of the muzzle; and the eyes, which are black, and about the same size as those of a shark, are placed in the same longitudinal lines with the nostrils, and separate mid-way between them and the openings of the ears. These openings are near the neck, and very small for the size of the animal.

The swimming paws are situated immediately under the neck, and they enable the animal not only to keep itself steady to the action of the tail in swimming, but to hold on upon the crags of the rocks, from which it bites the sea-weed. This animal attains the length of at least five-and-twenty feet, and measures about eighteen in circumference at the thickest part. The weight, when of this size, is between three and four tons.

These animals are gregarious, and assemble in numerous troops in the bays when the weather is calm, and they often enter the mouths of rivers. In their progress the old ones generally surround the young, in order to protect them from danger. They pair in spring, and bring forth in autumn, the period of gestation being understood to be nine months. They swim with about half the body above the surface of the water. In stormy weather they come near the shores; and in winter, when the shallow water freezes to a considerable distance southward, they are scantily fed, and by the time that the ice clears away they get very lean.

The inhabitants of eastern Asia, especially of Kamtschatka, the Aleutian Islands, and other adjoining parts, pursue these animals with great assiduity, esteeming them the most valuable products of the sea. Their tough hides serve them for boats, which are generally stretched upon ribs of bone or whalebone, and they are very light and buoyant. The flesh is much relished by some of these semi-barbarous tribes. In the old animals it is tough, and requires a great deal of cooking; but in the young it is something intermediate between veal and pork. The fat of the young very much resembles that of the hog.

These animals are exceedingly numerous in the part of the sea to which allusion has been made, more so perhaps than any cetacea are in any other part, if we except the manati in some parts of the rivers of South America. As they are surface animals, and do not frequent the deep water, except on their voyages from place to place, they are very conspicuously seen, and give a character to the seas in which they are found. It is said that bones, though no living individuals, have been seen in the Greenland seas; and if it be true, as it is highly probable, that the point of lowest temperature is the situation of the magnetic pole, it is by no means unlikely that they may pass from sea to sea further to the north.

CETERACH (Willdenow), is an English fern, called by Linnæus, *Asplenium Ceterach*, and *Grammitis Ceterach* by Swartz. It has been long used medicinally.

CETOCHILUS. A minute genus of crustaceous animals, belonging to the order *Branchiopoda*, section *Lophyropoda*, sub-section *Carcinoida*, and nearly allied to the genus *Cyclops*, from which it differs in having a pair of eyes. These little animals are about one-sixth of an inch long, of an oblong-oval form, and are furnished with two very long, and two short antennæ, a mouth, five pairs of short foot-jaws, and five pairs of swimming, bifid, and ciliated legs, with a small narrow five-jointed abdomen, the last segment of which is provided with several long setæ.

This genus was established by M. Roussel de Vauzème, in the Annales des Sciences Naturelles for the year 1834, and affords a most interesting instance of the great share which the minute tribes of annulose animals take in the economy of nature.

The little creatures of which this genus is composed inhabit the Pacific and Atlantic oceans, beyond the 42° of south latitude; where they swarm to such an extent, that, at certain seasons, they form dense masses upon the surface of the sea, to which, from their being of a bright red colour, they give a bloody appearance, serving also for food for the whales which abound in those parts of the ocean.

It had been long known that whales feed upon various minute animals. Fish also, and crustaceous animals, as well as medusæ, serve for their food; but, in general, direct observations upon the genera and species of these latter animals are wanting in the works of travellers—a want which we trust the establishment of those societies, which are peculiarly devoted to various branches of zoological knowledge, will tend to supply, by first showing the necessity for such observations.

M. de Vauzème, who accompanied a party of whale fishers to the southern ocean, has, to a considerable degree, made known various interesting circumstances respecting those animals, which are in various ways connected with the whale, including those of the *Cetochilus australis*. This expedition remained near the islands of Tristan d'Acunha for four months, occupied daily in fishing, and without discovering the animals upon which the whales feed. In passing, however, thence to Cape Horn, in the month of February, the surface of the sea was discovered one morning to be streaked as though with blood, in red lines many leagues long. The experienced fishers immediately announced that they were arrived at the station of the whales, and shortly afterwards some of these monsters of the deep were seen sporting in the midst of these bloody streaks. The sea also appeared to be in a constant ebullition from the rapid movements of these living masses, which gave to it so extraordinary an appearance. On examining the living animals whilst in motion, the hind legs were observed to be directed towards the head, and by a sudden movement thrown backwards, so as to give the body a progressive jerking kind of motion; the large antennæ were also curved in a semi-circle round the sides of the body, and appeared to assist in locomotion. Although conglomerated in the ocean in compact and regular masses, each animal in the space it occupies possesses sufficient liberty for all its movements. Sometimes during rough weather, whole shoals of these animals were lifted with the waves above the surface of the sea, falling upon the sails and other parts of the vessel. The whales devour myriads of them. The American fishermen term these red shoals of animals the food of the whale; and they informed M. Vauzème, that, during the months of October and November, they remain hidden in the depths of the ocean. Later in the season, and when they are ready to deposit their eggs, they come to the surface of the sea. This circumstance therefore is noted by the sailors as the sign of the departure of the whales, which shortly afterwards approach the bays. After the eggs are deposited, these red streaks upon the surface of the sea become yellow. The food of the whales is then technically said to be ripe, and the whales soon depart. This change of colour, produced by the presence of the eggs, M. Vauzème was informed by experienced fishers, takes place soon after the appearance of the animal, although he did not observe it himself.

END OF VOL. I.

Bradbury and Evans, Printers (late T. Davison), Whitefriars.

BIGNONIACEÆ.

Jacaranda Mimosifolia.

Tecoma Radicans.

F. W. Smith del. et sc.

Bignonia Grandiflora

London, Published by Orr & Smith, Amen Corner, Paternoster Row.

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AMARYLLIDEÆ.

Amaryllis Formosissima.

Amaryllis Belladonna.

Crinum Giganteum.

Hæmanthus Coccineus.

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APES.

1 Black Gibbon
2 Ourang Outang
3 Chimpanse

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BIRDS OF PARADISE.

1 Paradisœa Apoda	3 Paradisœa Ruber
2 Paradisœa Regia	4 Paradisœa Magnifica

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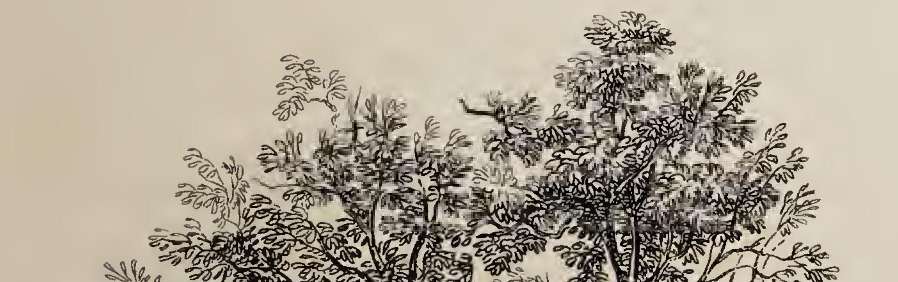
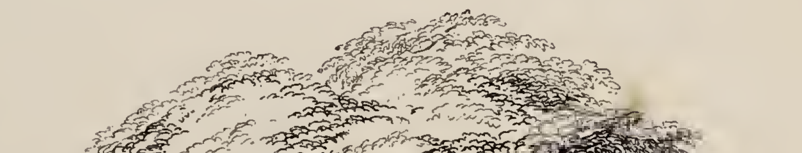
Oak. (Quercus Sessiliflora.)



Plane Tree. (Platanus Occidentalis.)



White Poplar. (Populus Alba.)

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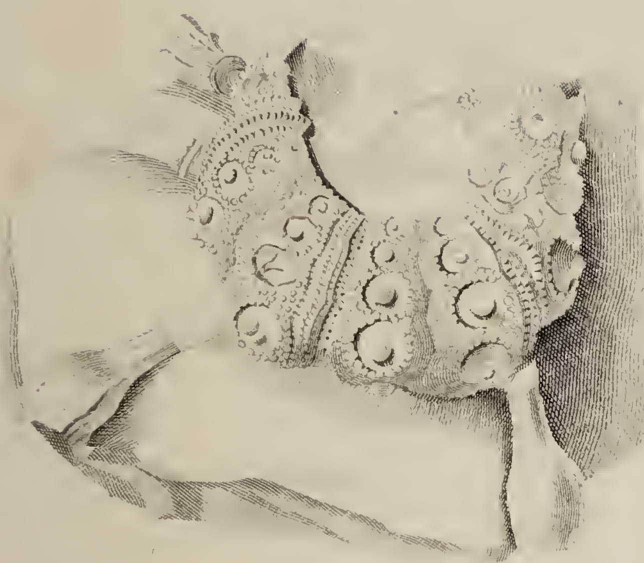

Cidaris Claviger, (from the Chalk, Northfleet, Kent.)

Cidaris Sceptifera (from same place.)

Fish, from the Chalk, Northfleet.

Hamites Compressus, (from the Gault Speeton, Yorkshire.)

[illegible]h del. et Sculp.

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Gnu Gazelle

Koedoe Leucoryx

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