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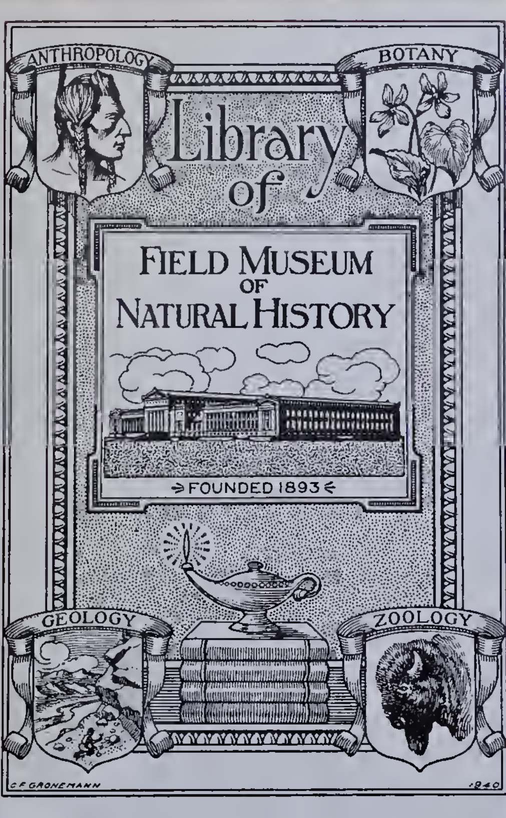
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# ZOOGRAPHY;

OR, THE

# Beauties of Nature Displayed.

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OR, THE

## Beauties of Nature Displayed.

IN

SELECT DESCRIPTIONS

FROM

THE ANIMAL, AND VEGETABLE,

WITH ADDITIONS FROM

THE MINERAL KINGDOM.

*SYSTEMATICALLY ARRANGED.*

BY W. WOOD, F. L. S.

ILLUSTRATED WITH PLATES, DESIGNED AND ENGRAVED
BY MR. WILLIAM DANIELL.

IN THREE VOLUMES.

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THIRD VOLUME.


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# ZOOGRAPHY;

OR, THE

# Beauties of Nature Displayed.

## PLANTS.

It is a truth familiar to our experience, that all the subjects of the vegetable kingdom (however propagated afterwards) were originally produced by seeds; and it must be obvious to every one, that the perfecting of the seed is one great intention of Nature in the structure of plants. The contrivance manifested to accomplish this important design, will be readily observed as we proceed to trace the plant through its different stages, to a state of maturity.

Before we descend to particulars, it will be necessary to observe, that all the seeds of plants have different sheaths, which enclose them till they are lodged in the earth. This covering so defends them from injury, that they may be handled very roughly without the smallest prejudice to their future growth. Some of these seeds, as the kernels of apples and pears, are placed in the very heart of the fruit. Others grow in shells, such as peas and beans. A third sort, besides their enclosure in the substance of the fruits, are shut up in thick shells of wood; of this species are almonds, apricots, peaches, plums, &c. Several, besides their wooden shell, have a bitter rind, which is the case of walnuts; or a covering jagged with prickles to preserve the seed from all injury till they have completed their maturity: chestnuts belong to this last class.

We must here remark a wonderful effort of Nature for the dispersion of the seeds after they have arrived at maturity. While shut up in their respective capsules, they can be of no service, since the very covering which defends them from injury will prevent their vegetating. But this difficulty, great as in many instances it appears, is removed by the power of Nature; and nuts and shells, which bid defiance to our teeth, will gradually divide and make way for the little tender sprout which proceeds from the kernel.

### *Progress of Vegetation.*

The common garden bean is usually chosen to exemplify the progress of vegetation, and the subject is certainly very fit for the purpose; since its parts, after it begins to vegetate, are more conspicuous than many others, and consequently better calculated for investigation.

The tender parts of the bean, like most other seeds, are covered by one *epidermis*, or skin, which consists of two coats, or membranes, that may be easily separated from the bud after the bean has been boiled, or deposited for a few days in the earth. When this covering is removed, the body of the seed divides into two smooth portions or lobes. Previous to the removal of the external coat a very small hole may be perceived at the thick end of the bean, through which the future root passes into the soil. The little bud, that precious particle which in time is to become a fruitful plant, is sunk like a small stud on the top of the lobes, and consists of a stock and a pedicle. This minute germ is enclosed within corresponding cavities in each lobe; and the two ends of it, in shooting from the body of the bean, take contrary directions; the root descends into the earth through the little hole already mentioned, and there divides into a great number of smaller branches, which serve as so many canals to convey the necessary sap for the nourishment of the future plant. The bud, on the contrary, ascends into the open air, where it unfolds itself, and by degrees shoots into that beautiful assemblage of stem leaves and flowers, which are so conspicuous in most of the vegetable creation.

In the structure, and for the preservation, of this embryo plant, as much contrivance is shown, as in subjects of much more apparent importance. The animal, when first brought into the world, has its nourishment supplied by a different source indeed, but not by a contrivance more manifest than this; for the young plant, before its roots are strong enough to draw a sufficient support from the earth, is nourished by the lobes; which, like milk to the new-born animal, invigorate the tender stem till their services are no longer required.

In the germination of seeds, a fact may be observed which will prove how careful Nature has been to provide against any failure in her operations. If a seed is thrown into the ground—it matters not of what species, or in what direction—the root will invariably strike downwards, and the bud find its way into the air. The late archdeacon of Carlisle, whose works are so deservedly admired, has the following passage to this effect in his Natural Theology: "When a grain of corn is cast into the ground, this is the change which takes place. From one end of the grain issues a green sprout; from the other a number of white fibrous roots. How can this be explained?—Why not sprouts from both ends? Why not fibrous threads from both ends? To what is the difference to be referred, but to design; to the different uses which the parts are hereafter to serve; uses which discover themselves in the sequel of the process? The sprout, or plumule, struggles into the air, and becomes the plant, of which, from the first, it contained the rudiments: the fibres shoot into the earth; and thereby both fix the plant to the ground and collect nourishment from the soil for its support. Now, what is not a little remarkable, the parts issuing from the seed take their respective directions, into whatever position the seed itself happens to be cast. If the seed be thrown into the wrongest possible position, that is, if the ends point in the ground, the reverse of what they ought to do, every thing, nevertheless, goes on right. The sprout, after being pushed down a little way, makes a bend and turns upwards; the fibres, on the contrary, after shooting at first upwards, turn down."

The inference which we must draw from all this is evident. It is one of Nature's laws for the preservation of her products, which can never be overturned. "For," says Paley, "the toil of the husbandman would have been in vain; his laborious and expensive preparation of the ground in vain; if the event must, after all, depend upon the position in which the scattered seed was sown. Not one seed out of a hundred would fall in a right direction." This is certainly a very curious phænomenon; for although almost all plants rise a little crooked, and will go out of their way to avoid any obstruction which they may meet with in their passage to the surface of the earth, and will even make a second bend, or elbow, without rectifying the first; yet will they afterwards shoot up perpendicularly, never leaving the ground in an irclined position. This singular circumstance, like a great many others which occur every day, is looked upon without the smallest surprise; and, for want of novelty, is passed by unnoticed: but the naturalist, who is in the habit of observing every operation of Nature, will find the subject sufficiently interesting to arrest his attention.

Having thus briefly described the manner in which the young vegetable shoots from its sheath, and bursts into life; we shall leave the further consideration of seeds for the present, and proceed to the other essential parts of the plant, beginning with the root.

### *The Root.*

Every root, after it has arrived at a certain age, has a double skin. The first exists in the seed, and is sent out with the radicle; but afterwards there is a ring, which grows from the bark and forms a second skin. This becomes loose; and in the dandelion, towards the end of May, the outer skin appears shrivelled, and is easily separated from the new one, which is fresher, and adheres firmly to the bark. In this respect the roots of plants resemble many of the reptile tribe, which annually change their skins. Perennial plants, in particular, are supplied in this manner with a new skin every year; the outer one falling off in the autumn or winter, and a new one supplying its place in the spring.

There is a bark covering the roots of trees, which in most species is very thin in proportion to the wood and pith; but this is not the case with succulent vegetables, such as carrots, in which the bark forms almost one half of the semidiameter of the root, and in dandelion it is nearly twice as thick as the woody part.

The bark is composed of two substances; the pulp, which is the principal part, and a few woody fibres. The pulpy part is full of pores, or vessels, which are not pervious so as to communicate with each other; but consist of distinct little cells or bladders, scarcely visible without the assistance of a microscope. In all roots these cells are constantly filled with a thin watery liquor. In many roots, as the horse-radish, asparagus, potatoe, &c. the pulp is of an uniform structure. But in others it is more diversified, and puts on the shape of rays, running from the centre towards the circumference of the bark. These rays generally stand at an equal distance from each other, in the same plant; but the distance varies greatly in different plants. A number of ligneous vessels are dispersed through the substance of the root, which are tubular, and serve for the conveyance of the sap to nourish the trunk and branches. These vessels are disposed in a longitudinal direction, and ascend the whole length of the plant. Instead of running in a direct line, as we should naturally expect to find them; they incline at small distances, towards each other, so as to form packets of fibres, connected together by the pulpy substance of the root. Thus the vessels pass in an oblique direction from one range to another, so as somewhat to resemble the meshes of a large net; and in such a manner that the fibrous vessels frequently admit of spaces between them, which are sometimes in the form of a lozenge, sometimes square, but generally oblong. In all plants they are most numerous towards the inner edge of the bark. It is unnecessary to add, that roots differ exceedingly in their formation, as this must be obvious to every one; the bulbous, the taper, and the fibrous root being constantly in use for culinary purposes.

### *The Trunk.*

In passing to the trunk of the tree (the observations on which apply equally to the branches) it will be necessary to premise, that it is only a continuation of the same parts we have already described, though frequently very different in its texture and appearance.

The bark is the first thing which occurs to our notice, the principal body of which consists of pulp, and an innumerable assemblage of minute vessels. This part of the tree may be divided into the inward bark, or fine skin immediately contiguous to the wood; the epidermis, or outward skin, which is a net extending over all the exterior surface of the tree; and the intermediate bark, or thick substance between the two preceding skins.

The fine bark is a very singular production in trees; it seems to be a collection of little skins, or a tissue of fibres glewed over one another; the first and innermost round of which disengages itself from the rest in the spring, and adds a new circumference to the wood through its whole length. Trees, like insects and reptiles, have several skins folded over one another; but with this difference, that reptiles and insects divest themselves of these first skins, and entirely quit them, to appear, from time to time, in a new form, and with additional splendour; whereas trees have annually a new habit, but then it is cast over the preceding, and merely serves to form an additional ring. It is evident that the fine bark furnishes the tree with the rounds of fibres that yearly enlarge its bulk, because when the large bark, with that which is inward, is cut off in any part, leaving the wood exposed to view, the wood will never receive any augmentation there; both the bark and the wood continue their growth in the adjoining parts, but the aperture remains as it was first made, and can only be closed in process of time, by the lengthening of the protuberances formed by the neighbouring fibres.

It is easy to distinguish the annual accretions in trees. It is only necessary to cut a trunk, or a large branch, horizontally, to discover the several circles, or different degrees of thickness round the heart; and we may infallibly determine the years of the tree's age, by the number of circles visible in the wood: the last revolutions are always of a lighter consistence; they are called the sappy parts of the wood, and are rejected by workmen, as too light to be any way serviceable to their purpose. These soft parts contract a solidity in the succeeding years;

they likewise become more compact, and in no particular differ from the real wood. The tree, by its perpetual increase in strength and circumference, forces the fibres of the bark to stretch and extend themselves, so that the outward surface sometimes bursts with a surprising noise: this occasions the crevices, which are always enlarging the external bark in proportion to the growth of the tree.

Immediately under the bark lies the wood, which forms by far the greatest part of the trunk and large branches of trees. The layers of which it consists, and which, as we have just remarked, determine the age of the tree, are chiefly composed of longitudinal fibres that once afforded a passage for the sap, but whose orifices are obliterated by compression, and become solid and impervious. The pith, which in the large trunks of many trees disappears altogether, occupies the centre of the wood, and consists of a system of little cells separated by interstices or partitions of a very thin texture. Anatomists have compared the cells to bladders.

We have observed that the bark, as well as the sappy parts, is composed of long rows of tubes or hollow fibres, that ascend and join together, or have a communication with one another by the agency of transverse fibres; which consequently leaves several spaces between these fibres. All these kinds of open meshes are filled with little vessels, or bags, of an oval form, pierced at the two extremities, and joined to one another at each end like a string of beads; ranged at the same time in heaps one above another, and extending in a horizontal line from the outward bark across the other two, and the wood, and so to the pith itself: these vessels are generally filled with sap. Beside the fibres that ascend from the root, and constitute the wood and bark, there are other vessels disposed in the same manner, and ranged along the fibres at proper intervals of distance, through the trunk and branches of the wood; these form the air vents, and the vessels properly so called. They are a set of tubes, composed of fibres revolving in a spiral line, and in one part extended in little ramifications to the external air; in the other continued and enlarged to the very root. These vessels are always empty.

### *The Sap.*

The consideration of the vessels which are appointed for the conveyance of nourishment to the different parts of the plant, naturally leads us to the circulation of the sap, about which such contradictory opinions have been maintained. Some suppose that the vegetable sap circulates in the plant in the same manner that blood does in animals; while others affirm that it only ascends in the day-time, and descends again in the night: these different opinions have both had their advocates; but as the most powerful reasoning seems to be against the regular circulation of the sap, we shall confine ourselves to that side of the question, and relate some few of the arguments which Dr. Hales has made use of to establish the point.

In the *Vegetable Statics*, the Doctor has recorded a great many experiments, the result of which tends to prove that he is right in his conjecture respecting the non-circulation of the sap; but as these experiments are by far too numerous to be inserted in this place, we shall content ourselves with some of his general observations.

"In animals," says the Doctor, "it is the heart which sets the blood in motion, and makes it continually circulate; but in vegetables we can discover no other cause of the sap's motion but the strong attraction of the capillary sap-vessels, assisted by the brisk undulations and vibrations caused by the sun's warmth, whereby the sap is carried up to the top of the tallest trees, and is there perspired off through the leaves: but when the surface of the tree is greatly diminished by the loss of its leaves, then also the perspiration and motion of the sap are proportionably diminished, as is plain from many of the foregoing experiments: so that the ascending velocity of the sap is principally accelerated by the plentiful perspiration of the leaves, thereby making room for the fine capillary vessels to exert their vastly attracting power, which perspiration is effected by the brisk rarefying vibrations of warmth; a power that does not seem to be any ways well adapted to make the sap descend from the tops of vegetables by different vessels to the root.

"If the sap circulated, it must needs have been seen descending from the upper part of large gashes cut in branches set in water, and with columns of water pressing on their bottoms in long glass tubes. In both which cases, it is certain that great quantities of water passed through the stem, so that it must needs have been seen descending, if the return of the sap downwards were by trusion or pulsion, whereby the blood of animals is returned through the veins to the heart; and that pulsion, if there were any, must necessarily be exerted with prodigious force, to be able to drive the sap through the finer capillaries. So that, if there be a return of the sap downwards, it must be by attraction, and that a very powerful one, as we may see by many of these experiments. But it is hard to conceive what and where that power is which can be equivalent to that provision Nature has made for the ascent of the sap in consequence of the great perspiration of the leaves.

"The instances of the jessamine-tree, and of the passion-tree, have been looked upon as strong proofs of the circulation of the sap, because their branches, which were far below the inoculated bud, were gilded; but we have many visible proofs in the vine, and other bleeding trees, of the sap's receding back and pushing forwards alternately at different times of the day and night. And there is great reason to think that the sap of all other trees has such an alternate receding and progressive motion, occasioned by the alternacies of day and night, warm and cool, moist and dry. For the sap in all vegetables does probably recede in some measure from the tops of the branches, as the sun leaves them;

because, its rarefying power then ceasing, the greatly rarefied sap, and air mixed with it, will condense, and take up less room than they did, and the dew and rain will then be strongly imbibed by the leaves; whereby the body and branches of the vegetable, which have been much exhausted by the great evaporation of the day, may at night imbibe sap and dew from the leaves; for, by several experiments, plants were found to increase considerably in weight, in dewy and moist nights. And, by other experiments on the vine, it was found that the trunk and branches of vines were always in an imbibing state, caused by the great perspiration of the leaves, except in the bleeding season; but when at night that perspiring power ceases, then the contrary imbibing power will prevail, and draw the sap and dew from the leaves, as well as moisture from the roots.

"The instance of the ilex grafted upon the English oak, seems to afford a very considerable argument against a circulation. For if there were a free uniform circulation of the sap through the oak and ilex, why should the leaves of the oak fall in winter, and not those of the ilex?"

These arguments, founded on many well conducted experiments, are strongly against the theory of an uniform circulation of the sap in vegetables, through different vessels, in the same manner as takes place in the animal œconomy; but that this matter may be cleared up as much as possible, we shall add the following decisive experiment, made by M. Mustel of the Academy of Sciences at Rouen.

"On the 12th of January I placed several shrubs in pots against the windows of my hot-house, some within the house and others without it. Through holes made for this purpose in the panes of glass, I passed a branch of each of the shrubs, so that those on the inside had a branch without, and those on the outside one within; after this, I took care that the holes should be exactly closed and luted. This inversed experiment, I thought, if followed closely, could not fail of affording sufficient points of comparison to trace out the differences by the observation of the effects.

"The 20th of January, a week after this disposition, all the branches that were in the hot-house began to disclose their buds. In the beginning of February there appeared leaves; and towards the end of it, shoots of a very considerable length, which presented the young flowers. A dwarf apple-tree, and several rose-trees, being submitted to the same experiment, showed the same appearance then as they commonly put on in May: in short, all the branches which were within the hot-house, and consequently kept in the warm air, were green at the end of February, and had their shoots in great forwardness. Very different were those parts of the same tree which were without, and exposed to the cold. None of these gave the least sign of vegetation; and the frost, which was intense at that time, broke a rose pot placed on the outside, and killed some of the branches of that very tree which, on the inside, was every day putting forth more and more shoots, leaves, and buds; so that it was in full vegetation on one side, whilst frozen on the other.

"The continuance of the frost occasioned no change in any of the internal branches. They all continued in a very brisk and verdant state, as if they did not belong to the tree, which, on the outside, appeared in the state of the greatest suffering. On the 15th of March, notwithstanding the severity of the season, all was in full bloom. The apple-tree had its root, its stem, and part of its branches, in the hot-house. These branches were covered with leaves and flowers; but the branches of the same tree, which were carried on the outside, and exposed to the cold air, did not in the least partake of the activity of the rest, but were absolutely in the same state which all trees are in during winter. A rose-tree, in the same position, showed long shoots with leaves and buds; it had even shot a vigorous branch upon its stalk; whilst a branch which passed through to the outside had not begun to produce any thing, but was in the same state with other rose-trees left in the ground. This branch is four lines in diameter, and 18 inches high.

"The rose-tree, on the outside, was in the same state; but one of its branches, drawn through to the inside of the hot-house, was covered with leaves and rose-buds. It was not without astonishment that I saw this branch shoot as briskly as the rose-tree which was in the hot-house, whose roots and stalks, exposed as they were to the warm air, ought, it should seem, to have made it get forwarder than a branch belonging to a tree, whose roots, trunk, and all its other branches, were at the very time frost-nipped. Notwithstanding this, the branch did not seem affected by the state of its trunk; but the action of the heat upon it produced the same effect as if the whole tree had been in the hot-house."

In France we find Duhamel and Delahire contending for the regular and uniform circulation of this fluid in vegetables; and Mr. Knight, in some of the late volumes of the Philosophical Transactions, has supported an opinion to the same effect.

As soon as the spring commences, if the frost has left the ground, the sap begins to rise in plants, and that with such force, when the weather is favourable, that the cut end of a vine branch has supported a column of mercury $32\frac{1}{2}$ inches high. There can be no doubt that the sap flows from the root of the tree to the very extremity of its branches; for, if a number of openings be made in a tree when the sap is beginning to rise, it will first appear at the lowest wound, then at the next to the lowest, and so on successively, till it flows from the highest of all. This was proved in a pleasing manner by some foreign philosophers, who made plants vegetate in coloured liquors, and found that the wood became coloured as the sap rose, till at length it reached the top of the tree and tinged the very leaves.

A great part of the sap, after it has flowed to the leaves, is carried off by perspiration, and the quantity perspired has been proved, by several philosophers, to bear a great proportion to the moisture imbibed. We learn from the experiments of Mr. Woodward, that a sprig of mint in seventy-seven days absorbed 2558 grains of water, and yet its weight was only increased fifteen grains; therefore it must have perspired 2543 grains. Several other experiments were tried with similar results; all tending to prove the great evaporation which is continually taking place from the surface of plants. It must be remarked that light and heat greatly promote this perspiration; for in the night a much less quantity is carried off, and little or none during a frost, or while it rains.

### *Absorbing Power of Plants.*

A very singular part of the œconomy of vegetable substances (which proves, by the way, how careful Nature has been to make this part of the creation essentially serviceable to our health,) is their ability to absorb the bad air from the atmosphere, and at the same time to return what is fit for respiration in the room of it. We are indebted for this singular discovery to the indefatigable Dr. Priestley, who, in the year 1771, made a sprig of mint vegetate for ten days, in a quantity of air which had been previously vitiated and rendered unfit for respiration: in consequence of this vegetation, however, the bad air was so far improved as to suffer a candle to burn in it, and to be very nearly restored to its original purity. This pure air, or oxygen gas, is emitted in the greatest quantity when the plants are exposed to the bright light of day. The sun's influence appears to assist them powerfully in this process, and light is so essentially necessary that no respirable air is passed off from their leaves in its absence.

The air which is absorbed from the atmosphere by plants, is of the same nature as that which floats on all fermenting surfaces; it is well known in the brewery, and gives spirit to the mineral waters:—this used to be called fixed air, but is now named carbonic acid gas.

The leaves of plants are known to imbibe water as well as air; and this accounts for the great effect which dew, slight showers, and even wetting the leaves, have in recruiting the strength of the plants. M. Bonnet has proved, that leaves continue to live for weeks when one of their surfaces is applied to water, and that they not only vegetate themselves, but even imbibe enough to support the vegetation of a whole branch, and the leaves belonging to it. He discovered also, that the two surfaces of leaves differ very considerably in their absorbing power; that in trees and shrubs, the absorbing property is almost confined to the under surface, while the contrary holds in many other plants.

That all vegetables owe their green colour to the action of light, is sufficiently obvious, since a plant confined in a dark place will consequently be white; in this situation its natural propensity will not leave it, it will seek that which is intended to promote its welfare, and if there is a chink in the apartment which admits the light, it will grow towards it. If the plant be afterwards removed into the open air, it will soon lose its sickly appearance, recover, at least in a degree, its strength, and assume its natural colour. The knowledge of this fact has suggested to us the means of improving several of our succulent vegetables; and yet there are many gardeners who earth up their celery, and tie up their lettuces; and many persons who consume both, without being at all aware how this change is really effected.

### *Irritability of the Organs of Plants.*

This is a curious and interesting part of the vegetable œconomy; it occurs in many instances, and the motion produced is always the same in each individual, however frequently it may be repeated. A considerable number of plants are more or less irritable, according to their age, their strength, or the part which is touched. This is not only visible in their leaves, but extends to the flowers, and the different parts of fructification. Among other authors who have noticed this very curious property, we must not neglect to mention M. Duhamel, who has admirably described the motion of the sensitive plant. Bonnet, likewise, in his *Recherches sur l'usage des Feuilles,* has observed that, in their motions, they always present their surface to the open air, and that whenever the branches of the shrub are displaced the leaves constantly take a new position. Linnæus, again, has pushed his remarks on this subject still further. This celebrated naturalist watched the daily motion of the leaves of a considerable number of plants, and published his account of them in a dissertation entitled *Somnus Plantarum.* From having observed that many flowers open and shut regularly at certain hours in the day, he conceived an idea, as pleasing as it was ingenious, viz. that they form a kind of time-piece, to which he has given the name of *Flora's clock.* We shall hereafter have occasion to mention the *Dionæa muscipula,* and the *Hedysarum gyrans,* one of which is a remarkable instance of vegetable irritability, and the other of spontaneous motion.

Several observations have been made on the motion of the stamina of flowers, which prove that they are actuated by some secret impulse, which impels them to deposit the dust of their antheræ on the end of the pistil. The anthers of many species of lily, before they open, are attached lengthways to the filaments parallel to the style, and at the distance from it of nearly half an inch. The moment that the pollen, or dust, begins to be shed, the same anthers begin to move upon the filaments which sustain them ; they sensibly approach the stigma, one after another, and, having spread their fecundating dust upon that organ, retire almost immediately to their former stations. This movement is particularly apparent in the *Lilium superbum* Linn.

The stamens of the *Amaryllis formosissima,* the

*Pancratium maritimum,* and of the *Pancratium illyricum,* present us with a singular phænomenon, somewhat different from that which we have just noticed. The anthers of these plants, before the flowers blow, are, like those of the lily, attached lengthways to the filaments; but when the little boxes containing the pollen begin to open, they assume an horizontal direction, and sometimes turn upon the end of the filament as on a pivot, always presenting to the stigma that part of the anther from whence the fecundating dust is beginning to escape.

A still more obvious phænomenon, of a similar nature, may be observed in the *Fritillaria persica.* This plant has six stamens, which, before the flower has arrived at perfection, are removed from the style to the distance of a quarter of an inch, or more; but in a short time their situation is changed; for we perceive, almost directly after the flower is in bloom, that they alternately approach the style, and apply their anthers against the stigma. When they have effected their purpose, by shedding their pollen, they return in the order in which they approached, each taking the same place in the flower-cup which it occupied before. All this passes sometimes in the space of twenty-four hours. Movements analogous to these may be observed in the stamens of the *flowering rush,* and, though in a very slight degree, in some species of *garlic;* in the *star of Bethlehem,* and in *asparagus.*

But this irritability in the stamens is not confined to the liliaceous plants alone; it has been observed in many species of vegetables totally different from each other. The rues, for instance, present us with a striking example, and one that is easily put to the proof. All the plants of this genus have from eight to ten stamens; before the pollen is shed they may be seen to form a right angle with the pistil, arranged two-and-two in the concavity of each petal. When the time is arrived for the dispersion of their pollen, they form themselves two-and-two, or three-and-three, together, describing a complete quarter of a circle. Thus they bring their anthers towards the stigma; and after having deposited their pollen they retire to their former distance, and are again enclosed within the concavity of the petals. In the white dittany, *Dictamnus albus* Linn. we have another example to elucidate our present subject. Before the flower is come to perfection, the filaments that support the anthers bend towards the earth, so as almost to touch the base of the petals. As soon as the anthers are ready to open, and the pistil is fit to receive the pollen, the filaments bend, one after another, in an arch towards the style: by this sort of movement they place themselves immediately behind the stigma, so that the fecundating powder cannot fail to be spread upon that organ.

These examples will suffice to show how careful Nature is in this particular, to secure the preservation of the future plant, by fertilizing the tender seed at the bottom of the pistil, through the medium of the pollen. Many other instances of a similar nature might be brought forward, if necessary, to prove the same thing; but what we have already said, is enough to excite the attention of those who think the study of Nature worth their contemplation, and all we could add to the subject, would be of little avail to those who have no relish for such pursuits.

### *Dispersion of Seeds, and Preservation of Plants.*

There cannot be more manifest proofs of an all-directing power in the different departments of nature, than this; where such evident marks of contrivance are seen for the preservation of the embryo vegetable. It was clearly the intention of the Deity, that every part of the earth should be covered with plants; and to effect this purpose, he has adapted different species to different climates. Some will grow on the alpine heights and bear all the rigours of an inhospitable climate, while others flourish under the influence of a burning sun. But it was not sufficient that the same plants should for ever be confined to their own district. If this had always been the case, many species might in time have become extinct; they might have so choked each other as to prevent, either their own growth, or the propagation of their seeds. To prevent this, the Author of Nature has contrived to disseminate the seeds in a very wonderful manner: for this purpose, we find many endowed with what are not improperly called wings, the most familiar instances of which (among a great number) are the thistle and dandelion. These have downy appendages with which they may be seen floating in the air in great quantities, and are thus carried by the current to a considerable distance from the parent plant. Some are furnished with hooks, by which they adhere to the coats of animals, and are carried by them to a distance; while others are dispersed by birds, who carry them to different situations, where they are deposited and afterwards take root. It must not be omitted, that in many genera the seeds are dispersed with violence by the sudden bursting of the vessels which contain them. There is a remarkable instance of this, and one which we may command at pleasure, in the different species of fern. These plants, to the casual observer, appear to be without seeds; but, upon examining the under surface of their leaves, rows of conical dots may be seen, and in each little protuberance many a future fern is concealed. These little cones are covered by a very fine, thin, semitransparent skin, which bursts open before the seeds are ripe. The seeds themselves are enclosed within a globular capsule, which is surrounded by an elastic cord. When the seeds are ripe, the cord endeavours to become straight, and, by its elasticity, tears open the capsule and scatters the seeds. These are very minute objects, and hardly visible to the naked eye; but, by the assistance of a good single microscope and reflecting speculum, they may be clearly detected. In the months of September and October, this curious mechanism is very evident in the common brakes, and in the hart's-tongue; but the sudden jerk of the springing cord frequently carries the seeds out of the field of the microscope, and sometimes defeats the purpose of the observer. The common horsetail, which pushes up its solitary club-shaped head in the spring, affords another instance of this singular mechanism. The seeds of this plant are minute oval bodies, with two, three, or four slender threads attached to each. If the ripe fern be shaken over a piece of white paper, a greenish powder falls out, which at first appears full of animation, but soon becomes quiet. This powder is the seed, and the motion is occasioned by the contraction of the elastic threads; for a good microscope readily discovers all this, and exposes to our view the little oval bodies with their slender threads. Moisture will immediately put the whole collection into motion; the slightest breath will make the threads coil about the seeds, but in a moment, becoming dry, they expand again: after several expansions and contractions, they detach themselves, still contracting when moistened, and gradually bending from a straight line into a circle. They are so very susceptible of moisture, that, Dr. Withering informs us, if a drop of water be pushed toward them, they will contract before it touches their bodies. This property is so very singular, that a person unacquainted with the cause might readily be excused for supposing each seed a living insect.

Some seeds assist their projection to a distance in a very surprising manner. The crupina, a species of centaury, has its seeds covered over with erect bristles, by which assistance it creeps and moves about in such a manner, that it is by no means to be kept in the hand. If you confine one of them between the stocking and the foot, it creeps out either at the sleeve or neck-band, travelling over the whole body. If the bearded oat, after harvest, be left with other grain in the barn, it extricates itself from the glume; nor does it stop in its progress till it gets to the walls of the building. This progression is purely mechanical, and is thus effected: every oat has a spiral awn or beard annexed to it, which contracts in wet and extends in dry weather. When the spiral is contracted it drags the oat along with it: the arista being bearded with minute hairs pointing downward, obliges the grain to follow; but when it expands again the beard cannot go back to its former place, on account of its roughness, which bending the contrary way prevents the return of the oat.

The care which Nature takes to nourish her productions, to defend them from injury, and to support those which are too weak to bear their own weight, is sufficiently obvious in many of the vegetable tribe. To enter fully upon this subject would be foreign to our purpose; but a few instances may be selected that will serve as examples of the whole.

There is no where a more manifest proof of design in respect to the care which Nature takes to nourish the embryo plant, than in the jacobean lily. This is a familiar example, and worth a hundred of those which can easily be recorded, but with difficulty put to the proof. The pistil in this plant (when sufficient heat is given it to make it flower in perfection) is bent downwards, and from its stigma issues a drop of limpid fluid, so large that one would think it in danger of falling to the ground. It is, however, gradually reabsorbed into the style about three or four o'clock, and becomes invisible till about ten the next morning, when it appears again; by noon it attains its largest dimensions; and in the afternoon, by a gentle and scarcely perceptible decrease, it returns to its source. If we shake the antheræ over the stigma, so that the pollen may fall on this limpid drop, we see the fluid soon after become turbid, and assume a yellow colour; and we perceive little rivulets, or opake streaks, running from the stigma towards the rudiments of the seed. Thus is the little germ, which is seated at the bottom of the pistil, nourished and brought to maturity by a process as simple as it is obvious.

Among those instances which may be brought forward to prove how carefully the tender parts of plants are defended from injury, is the autumnal crocus, or meadow saffron. The forlorn state of this plant attracted the notice of the late Dr. Paley; who, though he has added nothing new in respect to its natural history, has described it in a manner so truly his own, and has placed it in such an interesting light, that we shall gladly avail ourselves of his account.

Speaking of the *compensatory* system in the autumnal crocus, the doctor says: "I have pitied this plant a thousand times. Its blossom rises out of the ground in the most forlorn condition possible; without a sheath, a fence, a calyx, or even a leaf to protect it; and that not in the spring, not to be visited by summer suns, but under all the disadvantages of the declining year. When we come however to look more closely into the structure of this plant, we find that instead of its being neglected, Nature has gone out of her course to provide for its security, and to make up to it for all its defects. The seed-vessel, which in other plants is situated within the cup of the flower, or just beneath it, in this plant lies buried ten or twelve inches under ground within the bulbous root. The tube of the flower, which is seldom more than a few tenths of an inch long, in this plant extends down to the root. The styles always reach the seed-vessel; but it is in this, by an elongation unknown to any other plant. All these singularities contribute to one end. 'As this plant blossoms late in the year, and, probably, would not have time to ripen its seeds before the access of winter, which would destroy them, Providence has contrived its structure such, that this important office may be performed at a depth in the earth out of the reach of the usual effects of frost *.' That is to say, in the autumn nothing is done above ground but the business of impregnation; which is an affair between the antheræ and the stigmata, and is probably soon over. The maturation of the impregnated seed, which in no other plants proceeds within a capsule, exposed together with the rest of the flower to the open air, is here carried on, and during the whole winter, within the heart, as we may say, of the earth, that is, 'out of the reach of the usual effects of frost.' But then a new difficulty presents itself. Seeds, though perfected, are known not to vegetate at this depth in the earth. Our seeds therefore, though so safely lodged, would after all be lost to the purpose for which all seeds are intended. Lest this should be the case, 'a second admirable provision is made to raise them above the surface when they are perfected, and to sow them at a proper distance;' viz. the germ grows up *in the spring*, upon a fruit-stalk, accompanied with leaves. The seeds now, in common with those of other plants, have the benefit of the summer, and are sown upon the surface. The order of vegetation externally is this: the plant produces its flowers in September; its leaves and fruits in the spring following."

In the third place, those which are too weak to support their own weight, are provided with tendrils, by which they are enabled either to form an

* *With. Bot. Arr.* vol. i. p. 360, 2d ed.

union, as it were, with each other, and thus mutually sustain themselves; or to cling round plants of a firmer texture, and thus effect the same purpose, though by somewhat different means. Here we must again have recourse to Dr. Paley, who considers the general property of climbing plants as strictly mechanical. "In these plants, from each knot or joint, or, as botanists call it, axilla of the plant, issue, close to each other, two shoots; one bearing the flower and fruit, the other drawn out into a wire; a long, tapering, spiral tendril, that twists itself round any thing that lies within its reach. Considering, that, in this class, two purposes are to be provided for, (and together) fructification and support, the fruitage of the plant, and the sustentation of the stalk, what means could be used more effectual, or, as I have said, more mechanical, than what this structure presents to our eyes? Why, or how, without a view to this double purpose, do two shoots of such different and appropriate forms spring from the same joint, from contiguous points of the same stalk?" It never happens thus in robust plants, or in trees. "We see not," says Ray, "so much as one tree, or shrub, or herb, that hath a firm and strong stem, and that is able to mount up and stand alone without assistance, *furnished with these tendrils*." Make only so simple a comparison as that between a pea and a bean. Why does the pea put forth tendrils, and the bean not; but because the pea cannot support itself, the bean can? We may add also as a circumstance not to be overlooked, that in the pea tribe these clasps do not make their appearance till they are wanted; till the plant has grown to a height to stand in need of support."

It has been suggested by the ingenious Dr. Percival, that plants have a power of perception which actuates their motions, and that to think otherwise is to deviate from the soundest rules of philosophy. However this may be, we must confess ourselves more inclined to believe that a mechanical impulse is the general cause of action in the vegetable creation, than that, like animals, they are endued with the powers both of perception and enjoyment. The doctor's speculations are published in the second volume of the Manchester Transactions; and, as a specimen of the ingenuity with which he has supported his opinion, we shall give the following extract: "Mr. Miller, in his late account of the island of Sumatra, mentions a species of coral, which the inhabitants have mistaken for a plant, and have denominated it *lalan-cout*, or sea-grass. It is found in shallow bays, where it appears like a straight stick, but when touched withdraws itself into the sand. Now, if self-moving faculties like these indicate animality, can such a distinction be denied to vegetables, possessed of them in an equal or superior degree? The water lily, be the pond deep or shallow in which it grows, pushes up its flower-stems till they reach the open air, that the *ferina fecundans* may perform, without injury, its proper office. About seven in the morning the stalk erects itself, and the flowers rise above the surface of the water: in this state they continue till four in the afternoon, when the stalk becomes relaxed, and the flowers sink and close. The motions of the sensitive plant have been long noticed with admiration, as exhibiting the most obvious signs of perceptivity. And if we admit such motions as criteria of a like power in other beings—to attribute them in this instance to mere mechanism, actuated solely by external impulse, is to deviate from the soundest rules of philosophizing, which directs us not to multiply causes when the effects appear to be the same. Neither will the laws of electricity better solve the phænomena of this animated vegetable: for its leaves are equally affected by the contact of electric and non-electric bodies; show no change in their sensibility whether the atmosphere be dry or moist; and instantly close when the vapour of volatile alkali or the fumes of burning sulphur are applied to them. The powers of chemical stimuli to produce contractions in the fibres of this plant may perhaps lead some philosophers to refer them to the *vis insita*, or irritability, which they assign to certain parts of organized matter, totally distinct from, and independent of, any sentient energy. But the hypothesis is evidently a solecism, and refutes itself: for the presence of irritability can only be proved by the experience of irritations; and the idea of irritation involves in it that of feeling."

Lastly, we may observe that the plants which are of the most benefit to mankind are dispersed in the greatest abundance; and that even in some of the desert parts of the world, there are vegetables which, by distilling water from their bodies, afford to thirsty animals the greatest possible luxury.

How solicitous has Nature been about the preservation of grasses, which, though not directly, are certainly indirectly of the utmost consequence to our welfare. They contribute, almost entirely, to sustain our most useful animals; their seeds afford nourishment to birds; and their leaves cover the earth, like a carpet, with a colour of all others the most refreshing to our sight. They are calculated to grow in almost any situation, and to bear the hardest treatment without being destroyed. The more they are trodden upon, the thicker they grow, and their roots increase in proportion as their leaves are consumed. Neither the scorching summer's sun, nor the severest attacks of winter, destroy these plants: for, on the return of spring, they begin to sprout afresh, and seem, as it were, with an officious haste, to deck the earth with a green livery, that, thus adorned in all her glory, she may invite us to go forth into the fields and enjoy the scene. But the care of Providence to preserve these very essential vegetables, is particularly evident in an observation which has frequently been made: viz. that herbivorous animals attach themselves to the leaves of grasses; and, if at liberty to range and choose, leave untouched the straws which support the flowers.

In the deserts of America, we meet with a plant growing, like the misleto, on the tops of the trees, and having its leaves turned at the base into the shape of a pitcher, with the extremity expanded: in these the rain is collected and preserved, for the benefit of birds and other animals. Again, the water-tree in Ceylon produces cylindrical bladders, covered with a lid; into these is secreted a most pure and refreshing water. There is likewise a kind of cuckoo-pint in New France, which, when broken, will afford a pint of excellent water. Thus has Nature been careful to accommodate the productions of every country to its inhabitants, and to produce subjects of admiration which cannot fail to raise our ideas towards the Creator of all things.

We shall conclude this Introduction with a description of those parts of a plant which are the very essence of its being—the flower and the fruit. Upon these Linnæus has founded his generic characters; and they generally consist of the *calyx*, the *corolla*, the *stamina*, the *pistillum*, the *pericarpium*, the *semina*, and the *receptaculum*. The first four of these parts belong to the flower; the last three to the fruit.

The *calyx*, or cup, is the termination of the outer bark of the plant, and is formed, in general, of different segments. It supports and protects the other parts of fructification, and forms a receptacle for the

*Corolla*, or blossom, which is that beautiful coloured part of the flower, so generally attractive. This is composed of one or more leaves called *petals*. These form a kind of palisade, with which Nature has encompassed the heart of the flower to cover it when necessary. The corolla, in most plants, opens at the rising of the sun, to receive the genial warmth; and closes more or less at the approach of rain or night, to keep off the moisture and cold. For the most part it forms a little vault, which encloses the seeds, and seems, with a kind of consciousness, to preserve the tender charge consigned to its care. At the bottom of the corolla there is, in many plants, a little appendage, which Linnæus calls the *nectarium*. This contains the sweet liquor which the industrious bees so well know how to procure: it is for this they search the bottom of each flower, and for this they chiefly visit every cup. There are few who, in their younger days, have not sucked this honeyed liquor from the flower of the woodbine.

The *stamina*, or chives, are those little fibrous pillars which are, in most plants, placed upon the receptacle within the corolla, and round the seed-vessel. They consist of two parts, the filament and the anther; the former serves as a foot-stalk to support the latter, which is a hollow shell, filled with a very fine powder. This powder, or dust, when the antheræ are ripe, is shed on the upper part of the pistil, from whence it is conveyed to the bud, as we have already seen in the jacobean lily. Where the pistillum is seated in one plant, and the stamina in another (of the same species), the antheræ have frequently an elastic membrane, which bursts at the appointed time, and disperses the dust to a considerable distance. This dust on a fine day may be seen, like a cloud, hanging about the common nettle.

The *pistillum* is that part of the flower in which the seed is inclosed. It is that erect column which is placed in the centre of the corolla, amidst the stamina; and is designed to receive the nutriment shed upon its top or style, by the antheræ, for the welfare of the bud. Without this necessary process, the plant would not produce fertile seeds. This organ may be divided into three parts: the germen, or bud, which in fact is the base of the pistillum; the style, which forms the shaft of the pillar; and the stigma, which, like a capital, surmounts the whole.

The *pericarpium* is the case which incloses the germen after it is grown to maturity. This case, or seed-vessel, in many plants, bursts with an elastic force, and scatters its contents to a considerable distance. Sometimes it opens at the top, sometimes at the bottom, and indeed in almost every possible direction. This seed-vessel, or, as it is very commonly called, the *capsule*, is composed of coats, which are strong when compared with the rest of the flower, as may be readily seen in the pea, whose capsule is a pod formed of two tough valves that open longitudinally. The pericarpium sometimes increases to an amazing comparative size, as in the gourd and the melon: it always greatly exceeds the size of the seeds, and assumes almost an infinite variety of forms. Thus in nuts and stone-fruits, the seed is incased in a strong shell, which is itself inclosed in a pulp or husk. In grapes and many kinds of berries, it is plunged in a glutinous syrup, contained within a thin skin; in apples and pears, imbedded in the centre of a firm fleshy substance; and in raspberries and strawberries, scattered on the surface of a soft pulp. These are only a few instances among an amazing variety which exists in the different trees, shrubs, flowers, and grasses, and which all tend to one great end—the preservation of the future plant.

# OLIVE.

DIANDRIA MONOGYNIA.

GENERIC CHARACTER.

Calyx erect, tubular: mouth with four teeth.

Corolla funnel-shaped, divided into four parts, the segments nearly oval.

Drupe oval, smooth, containing a single seed.

SPECIFIC CHARACTER.

OLEA EUROPÆA. O. foliis lanceolatis integerrimis, racemis axillaribus coarctatis. *Linn. Spec. Plant. Willd.* 1. p. 44.

Leaves lanceolate and entire; bunches axillary and compact.

α. OLEA COMMUNIS. *Ait. Hort. Kew.* 1. p. 13.

β. OLEA VERRUCOSA. *Willd.*

γ OLEA LONGIFOLIA. *Aiton.*

δ OLEA LATIFOLIA. *Aiton.*

ε OLEA FERRUGINEA *Aiton.* ζ. OLEA OBLIQUA *Aiton.* OLEA BUXIFOLIA. *Aiton.*

COMMON OLIVE. *Black. Herb.* pl. 213.

WE have enumerated several varieties of this useful plant, all of which yield the same kind of fruit, and are cultivated for the same purpose. The olive-tree may undoubtedly be placed in the first rank amongst those which are considered of the most use to mankind, and cannot be too highly valued for the delicate oil which is extracted from its fruit.

The olive, considered merely as a botanical object, does not afford any thing striking in its appearance. It is an evergreen, with oval, entire leaves, placed opposite to each other, the superior surface of which is a pale shining green, while the inferior side is whitish. The flowers are disposed in bunches, which spring from the axils of the leaves: the corolla is monopetalous, and divided at its edge into four parts: the colour of the flower is white, and it exhales an agreeable smell. The leaves indeed are always green, but the whole plant is of such a dull colour, that it would hardly be worth our attention, if it did not contribute, by its products, to enrich the inhabitants of the southern countries of Europe, and to benefit a large portion of mankind. Considered in this light, it truly deserves the title which it has obtained from Columella, and other antient writers, who style it the first of trees.

It is generally believed that the olive derives its origin from the south of Europe; but it is also found on the northern coasts of Africa, in Asia Minor, and in the neighbouring countries. At present it is to be found in almost all the temperate climates. It was from the Phocians that the Gauls were indebted for the knowledge of this plant. These people left Ionia when Cyrus attempted to reduce them to his power; and, after wandering about for some time, came into Gaul, founded Marseilles, and applied themselves to the cultivation of the olive-tree. Pliny attributes to Aristæus the invention of millstones for bruising the olives, and of presses for extracting the oil.

There are several different kinds of olive cultivated for the sake of their fruit in the southern parts of Italy, and grounds are there set apart for the purpose. All parts of the tree are very productive; abounding in suckers, and young shoots are continually pushing up from the roots. The best situation for an olive-ground is on the declivity of a hill, at a moderate height from the level of the sea, and with a southern aspect. The plants succeed particularly well in sandy, stony, or volcanic lands; and, on the contrary, produce but indifferent fruit when situated in clayey, moist, and swampy bottoms. It appears somewhat singular, that a tree which requires twenty or thirty years to arrive at its full growth, should be extremely sensible to the impression of cold. This, however, is the case with the olive, since all high situations are hurtful to the plant, and frost is often destructive to it; especially if it has been preceded by moisture. On this account the careful planter covers the shoots of the first year with straw, as soon as the winter commences; and thus shelters them from the cold north winds as long as he has any thing to fear from the severity of the weather.

Although it is highly necessary to defend the olive plants from the cold, it is as much so to supply them with a constant and regular heat during the greater part of the year. If fine fruit is expected from the tree, this circumstance must be considered; and therefore, as we have before observed, a southern aspect, properly sheltered from the cold winds, will be highly necessary. As a proof that warmth is the chief source from whence these trees derive their vigour; the olives planted about Lima, and in South Carolina, produce fruit three times as large as the same species cultivated in France.

The stem of the olive scarcely rises to the height of twenty feet, provided the inferior branches are suffered to expand; and, in general, they are careful to keep the tree as near the surface of the earth as possible, that the heat from the sun may be more condensed, the fruit brought sooner to maturity, and the crop collected with more ease. It appears, from the accounts we have from those who have attended to the cultivation of the olive, that it is necessary to scrape the rough bark from the trunk, since it harbours insects during the winter, retains the wet, and renders the tree more susceptible of cold. It is said to be by no means rare, to find the trunk of the olive-tree rotten from top to bottom, and pierced through in every direction.

Olive-trees are propagated in several ways; either by seeds, by cuttings, or by the shoots: but all the varieties, of which the French reckon twenty-one, will degenerate, if neglected, so as to approach the wild species in every respect. Under the most unfavourable circumstances the olive will produce its fruit. M. Amoreux saw one that had been totally neglected, grown into a perfect bush, choked with suckers, and damaged by cattle; nevertheless, in this state it bore fruit, though they were smaller and less numerous than when the tree was carefully looked after.

The propagation by seeds is almost rejected as too tedious a process. The common method is said to be by shoots, which, when care has been taken to engraft them properly, bear fruit in the space of eight or ten years. These shoots are engrafted when in flower; unless the operation has been delayed and the tree bears fruit; when it is thought sufficient to take off a ring of bark, two fingers breadth in extent, above the highest graft. The trees are planted in rows at a considerable distance from each other, and in a quincunx order: the best season to plant them in is the spring, at least in France, where they are more subject to severe winters than in Italy.

When olives are intended for preservation, they are gathered before they are ripe, and put into a tub of pickle, consisting of salt and water, flavoured with fennel, coriander, and rose-wood. Formerly they used a mixture of a pound of quicklime, with six pounds of newly sifted wood ashes; but of late, instead of these materials, they use nothing but a lye. This, it is alleged, softens the olives, makes them more agreeable to the taste, and less hurtful to the constitution. In some parts of Provence, after the olives have lain some time in the brine, they remove them, take out the kernel, and put a caper in its place. These olives they preserve in excellent oil; and when thus prepared they strongly stimulate the appetite. Olives perfectly ripe are soft, and of a dark-red colour. They are then eaten without any preparation, except only a seasoning of pepper, salt, and oil; for they are extremely tart, bitter, and corrosive.

Opposed to this kind, may be mentioned a species growing in the town of Piedmont Alife, ten leagues from Naples towards the north-east, which is perfectly sweet, and eaten without any preparation. M. Battiloso, who noticed this kind, tells us that the bishop of the place, and several gentlemen who reside there, cultivate it in their gardens under the name of the sweet olive. They assured him that the plant seldom failed to produce fruit once a year; that they never attempted to extract the oil from them, as they constantly gathered them in the month of October to supply their tables; and that the birds devoured them with extreme avidity.

The quality of the oil extracted from the olive, depends on the nature of the soil where the trees grow; on the kind of olive from which it is expressed; on the care which is taken in the gathering and pressing of the fruit; and likewise on the separation of the part to be extracted. The olives should be gathered for the purpose, when they are just at the proper degree of ripeness; for the extreme either way will be prejudicial to the oil. The leaves must likewise be carefully separated, or else they will communicate a disagreeable bitterness to the oil. When the situation is favourable, those species are cultivated which yield fine oils; otherwise they cultivate such trees as bear a great quantity of fruit, from whence they extract the oil for the use of soaperies and lamps.

When the olives are gathered, which is about the months of November and December, if they are put in heaps too thick, or left in that state too long, they will ferment and contract a bad smell; they are therefore put as soon as possible into baskets, or into bags made of wool or hair, and pressed immediately, in order to extract the fine oil. The want of this activity in preparing the oil, is the reason why so little really fine, and free from any bad flavour, is to be procured. M. Duhamel is averse to the mixing of sound olives with those in which a fermentation has already begun, and more so with such as are putrified: in both cases the oil which is extracted is of a bad quality, and unfit for preservation. In order to have the oil in its greatest purity, we must allow it to deposit its sediment, and then pour it off into another vessel. The oil extracted from the pulp only of olives, is the most perfect which can be obtained, and will keep for several years; but that which is extracted from the kernel only, or from the nut, or from the whole olive ground in the common way in public mills, has always more or fewer defects, loses its limpidity in a certain time, and is very apt to become rancid. With all the care that can be taken, olive-oil will lose its good qualities, and become disagreeable to the taste, after being kept a length of time. When the olive is over ripe it yields a large quantity of oil, which, however, is of an inferior quality; and it is from this attempt of the planter, to make the most of his produce, by leaving the fruit till it drops from the trees before it is pressed, that so much indifferent oil is received from the oil countries.

The taste for olives must be always acquired; since they are acrid, bitter, and extremely disagreeable, till we become used to their flavour. The Lucca olives, which are smaller than the others, have the weakest taste; the Spanish, or larger, the strongest; those from Provence, which are of a middling size, are generally the most esteemed.

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PAPYRUS.

*Designed by W. Daniell.*

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# PAPYRUS.

### TRIANDRIA MONOGYNIA.

#### GENERIC CHARACTER.

Calyx tiled; scales egg-shaped.
Corolla, none.
Seed single, naked, three-cornered.

#### SPECIFIC CHARACTER.

CYPERUS PAPYRUS. C. culmo triquetro nudo, umbella involucris longiore, involucellis triphyllis setaceis longioribus, spiculis ternis. *Linn. Spec. Plant. Willd.* 1. p. 288. no. 73.

Stalk naked and triangular; umbel longer than the involucrum; partial involucre three-leaved and bristle-shaped; spiculæ ternate.

C. enodis nudus, culmis e vaginis brevibus prodeuntibus, spicis tenuioribus. *Scheuch. Gram.* 387. t. 8. f. 14.

C. niloticus vel syriacus papyraceus. *Moris. Hist.* 3. p. 239. f. 8. t. 11. f. 41.

PAPYRUS. . . . *Bruce's Travels,* vol. 7. p. 117. 8vo. ed.

ALTHOUH the papyrus has long ceased to be useful, it still deserves to be noticed, since it was from this plant that the antients manufactured their paper.

The advantages which the Egyptians derived from their knowledge of the papyrus rendered it famous in their country, and caused it to be celebrated by the learned of other nations. Theophrastus, and Pliny after him, have both described the plant; but by no means in so clear and comprehensive a manner, as has been since accomplished by M. de Caylus, and by Mr. Bruce. The former of these gentlemen, towards the middle of the last century, published a learned dissertation *Sur le Papier du Nil*; and the latter, during his travels in Egypt, made several observations relating to the papyrus. Assisted by what these naturalists have said upon the subject, we shall proceed to lay before the reader the following account of this celebrated plant.

The Egyptians applied the papyrus to several purposes independent of the manufactory of paper. The roots sometimes served them for fire-wood, and were frequently formed into different domestic utensils. Of the stems, interlaced together, they constructed a kind of boat; and of the interior bark they made their sails, mats, their clothes, their cordage, and the coverlits of their beds. The boats made of the papyrus, resembled great baskets compactly woven together, and plastered with a resinous substance. It was probably in a vessel of this kind that Moses was exposed, when he was found by the daughter of Pharaoh, on the banks of the Nile. Although Pliny has expressly called these boats *naves papyraceæ*, we are not to believe that they were constructed entirely with the stems of this plant;

for they were partly formed of a thorny kind of wood. The antient Egyptians pretend that the crocodiles, out of respect to the goddess Isis, who was once afloat in one of these barks, will never hurt those who steer their vessels in her manner.

The inhabitants on the borders of the Nile eat the lower and succulent parts of the stem of the papyrus, after having baked it to make it more palatable; and they express the antiquity of their origin, hieroglyphically, by a fagot of papyrus, because they consider the plant as having afforded nourishment to their forefathers. Guilandin, who lived in the sixteenth century, saw the inhabitants eating the succulent part of the papyrus; and Bruce tells us that, at this day, the people in Abyssinia pursue the same practice, and that they likewise chew the root of Indian corn, and of every kind of cyperus.

But the chief use the Egyptians made of the papyrus, and that for which it justly became celebrated, was the making of paper. The time when this useful article was first invented, is involved in obscurity, and authors have differed in their conjectures about its antiquity. Varro dates the discovery from the time of Alexander the Great, when that prince founded the city of Alexandria in Egypt; but Pliny endeavours to establish a contrary opinion, and refers it to a more remote period, upon the authority of several Greek authors, who lived before the time of Alexander, and who speak of the papyrus.

This, however, is a matter of little consequence; we shall therefore attend to what is more particularly interesting in the history of the plant, the method of manufacturing it into paper. For this purpose, the thick part of the stalk being cut in two, the pellicle between the pith and the bark, or perhaps the two pellicles, were stript off, and divided by an iron instrument, which probably was sharp-pointed, but did not cut at the edges. This was squared at the sides, so as to be like a ribband, then laid upon a smooth table, or dresser, after being cut into the length that the leaf was required to be. These stripes, or ribbands, of papyrus, were lapped over each other by a very thin border, and then pieces of the same kind were laid transversely, the length of these answering to the breadth of the first. "The book which I have," says Bruce, "is eleven inches and a half long, and seven inches broad, and there is not one leaf of it that has a ribband of papyrus of two inches and a half broad; from which I imagine, the size of this plant, formerly, being fifteen feet long, was pretty near the truth. No such plant, however, appears now; I do not remember to have seen one more than ten feet high. This is probably owing to their being allowed to grow wild and too thick together, without being weeded."

It appears from the following observations of Mr. Bruce, that the woody part of the papyrus was used to cover the books made of the bark. "In a large and very perfect manuscript in my possession, which was dug up at Thebes, the boards are of papyrus root, covered first with coarse pieces of paper, and then with leather, in the same manner as it would be done now. It is a book one would call a small folio, rather than by any other name; and I apprehend that the shape of the book, where papyrus is employed, was always of the same form with those of the moderns. The letters are strong, deep, black, and apparently written with a reed, as is still practised by the Egyptians and Abyssinians. It is written on both sides, so never could be rolled up as parchment was; nor would the brittleness of the materials, when dry, support any such frequent unrolling."

The composition which the Egyptians used for ink must have been of a very durable nature, since a book which had probably lain for centuries, was still as legible as ever. This fact respecting the blackness of the letters, does not rest solely on the authority of Mr. Bruce, since others have observed the same. Some years ago there was to be seen, in the abbey of Saint-Germain-des-Pres, part of the epistles of Saint Augustin written on Egyptian paper, occasionally interleaved with parchment: although the manuscript was eleven hundred years old, yet the letters had preserved their blackness.

Mr. Bruce, who appears to have examined the papyrus with some attention, has given the following description of its form. "The head is composed of a number of small grassy filaments, each about a foot long. About the middle, each of these filaments parts into four; and in the point, or partition, are four branches of flowers: the head of this is not unlike an ear of wheat in form; but which in fact is but a chaffy, silky, soft husk. These heads, or flowers, grow upon the stalk alternately, and are not opposite to, or on the same line with, each other at the bottom.

"Pliny * says it has no seed; but this we may be assured is an absurdity. The form of the flower sufficiently indicates that it was made to resolve itself into the covering of one, which is certainly very small, and by its exalted situation, and thickness of the head of the flower, seems to have needed the extraordinary covering it has got, to protect it from the violent hold the wind must have had upon it. For the same reason, the bottoms of the filaments composing the head are sheathed in four concave leaves, which keep them close together, and prevent injury from the wind getting in between them.

"The stalk is of a vivid green, thickest at the bottom, and tapering up to the top †; it is of a triangular form. In the Jordan, the single side or apex of the triangle stood opposed to the stream, as the cut-water of a boat or ship, or the sharp angle of the buttress of a bridge, by which the pressure of the stream upon the stalk would be greatly diminished. I do not precisely remember how it stood in the lakes in Ethiopia and Egypt, and only have this remark in the notes I made at the Jordan.

* Lib. xiii. cap. 13. † *Pliny*, lib. xiii. cap. 11.

"The construction of the stalk of the papyrus seems to reproach Aristotle with want of observation. He says that no plant has either triangular or quadrangular stalks. Here we see an instance of the contrary in the papyrus, whose stalk is certainly and universally triangular; and we learn from Dioscorides, that many more have quadrangular stalks, or stems of four angles.

"It has but one root, which is large and strong, Pliny says, as thick as a man's arm*. So it was probably when the plant was fifteen feet high, but it is now diminished in proportion, the whole length of the stalk, comprehending the head, being a little above ten; but the root is still hard and solid near the heart, and works with the turning loom tolerably well, as it did formerly when they made cups of it. In the middle of this long root arises the stalk at right angles, so when inverted it has the figure of a T, and on each side of the larger root there are smaller elastic ones, which are of a direction perpendicular to it, and which, like the strings of a tent, steady it, and fix it to the earth at the bottom. About two feet, or little more, of the lower part of the stalk is clothed with long, hollow, sword-shaped leaves, which cover each other like scales, and fortify the foot of the plant. They are of a dusky brown or yellow colour. I suppose the stalk was cut off below about where these leaves end.

"The head is not upright, but is inclined, as from its size it always must be in hot countries, in

* Lib. xiii. cap. 11.

which alone it grows. In all such climates there is some particular wind that reigns longer than other, and this, being always the most violent as well as the most constant, gives to heavy-headed trees, or plants, an inclination contrary to that from which it blows."

The old botanists placed the papyrus among the grasses; and being at a loss to find out its proper genus, were content to call it merely by the name of papyrus: at the same time they found a plant in Sicily which they considered as a distinct species, and therefore made two kinds, one the Egyptian, and the other the Sicilian. Modern botanists, however, observed that these two plants were one and the same species of cyperus; accordingly they have not made any distinction between the Sicilian papyrus and that which was found on the banks of the Nile.

# SUGAR CANE.

### TRIANDRIA MONOGYNIA.

#### GENERIC CHARACTER.

Calyx, none.
Corolla bivalve: Valves oblong, sharp-pointed, and concave.
Seed single.

#### SPECIFIC CHARACTER.

SACCHARUM CYLINDRICUM. S. panicula spicata cylindrica, pedunculis unifloris, floribus muticis diandris, foliis planis, geniculis barbatis. *Sp. Plant. Linn. Willd.* 1. p. 323.

Panicle round and in the form of a spike; peduncle bearing a single flower; flowers without awns and having only two stamens; leaves plane, joints bearded.

SACCHARUM CYLINDRICUM, panicula spicata sericea, ramulis brevissimis composita, floribus muticis. *Lamarck. Encyclop.* 1. p. 588. pl. 40. f. 2.

IMPERATA ARUNDINACEA. *Cyrill. Icon. Rar. fasc.* 2. pl. 11.

SUGAR CANE. . . . . *Edw. West Ind.* 2. p. 232.

THIS plant, which has become of such vast importance to mankind, is found in several parts of the world. Barrow saw it growing in its wild state in Africa; Thunberg says it is a native of Japan; Osbeck found it in China; Cook in the South Sea Islands, and Bruce in Upper Egypt. We are likewise told that it still flourishes on the sides of Mount Hebla in Sicily, from whence it was conveyed to Spain, Madeira, and the Canary and Cape de Verd Islands, soon after they were discovered in the fifteenth century.

The account of a plant of so much consequence, producing such a revenue to our native country, and affording employment, both in its cultivation and produce, to so many thousands of our fellow-creatures, must not be slightly passed over. We shall therefore avail ourselves of the most authentic information which has been collected on the subject, and particularly acknowledge the assistance we have received from the work of Mr. Bryan Edwards.

The sugar cane is a jointed reed, terminated by a bunch of leaves, or blades, whose edges are sharply serrated. The body of the cane is strong but brittle, and contains a soft pithy substance, which affords a copious supply of that juice which is so well known for its saccharine properties. The joints of the cane are generally from one to three inches in length, and from half an inch to an inch in diameter, they shoot up sometimes to the height of seven feet, exclusive of the top which bears the leaves; but the growth of the plant varies according to the soil in which it is produced, and is therefore to be found from three feet and a half to the height already mentioned. It must be understood that we are speaking of the sugar cane in a state of cultivation, as it is in this state only that its history is completely known. The plants, when seen collectively, have a very pretty effect, and so strongly arrested the attention of Mr. Beckford, that, in his descriptive account of the island of Jamaica, he says a field of canes when standing in the month of November, and in *arrow*, or full blossom, is one of the most beautiful productions that the pen or pencil can possibly describe. This gentleman informs us that the plant, when ripe, is of a bright and golden yellow, and, where exposed to the sun, is in many parts very beautifully streaked with red; the top is of a darkish green at first, but at length becomes of a russet yellow. From the centre of the leaves shoots up an arrow, like a silver wand, from two to six feet in height, producing from its summit a plume of delicate white feathers which are fringed with lilac colour. In this state the plant makes a very elegant appearance, and well deserves the attention of the botanist.

It does not appear that the juice of the sugar cane was known at a very early period among the Greeks and Romans, and therefore we must suppose that the plant was not much cultivated for its produce in the East till after a certain period, which cannot be readily ascertained. If the plant had been cultivated in India and Arabia, as Mr. Edwards supposes, from time immemorial; surely the Greeks and Romans, who traded with most of the countries known at that time, would have availed themselves of its luscious juice; and if so, some of their authors, whose works have escaped the ravages of time, would probably have mentioned the circumstance.

It would be foreign to our purpose to trace the first use of sugar amongst mankind, especially as a minute history of this substance, in the early and middle ages, has been given in the Manchester Transactions, by Dr. Falconer; we shall therefore merely add, that the sugar cane was first made known to the western parts of the world by the conquests of Alexander the Great, whose admiral Nearchus found it in the East Indies 325 years before Christ; and that Dioscorides mentions a kind of honey growing in the earth, called *saccharon*, which has the appearance of salt, and is brittle between the teeth. From this we may suppose that the art of granulating the juice of the cane was known in his time.

The question whether the sugar cane grew spontaneously in the West Indies, or was conveyed thither for the purpose of cultivation, was for some time agitated by different authors; till at length the arguments of Labat seem to have settled the point, and proved it to be a native both of the islands and of the continent of America. His testimony has been greatly strengthened by the discoveries of captain Cook, who found the cane growing wild on many of the islands in the Pacific Ocean.

Having thus described the appearance of the plant, and mentioned the different parts of the world where it has been found, we shall proceed to the manner in which it is cultivated for commercial purposes, and shall conclude with the process of making sugar, as it is practised at present in the West Indies.

The sugar cane is propagated by the top shoots, which are cut from the old canes; and the following is the method of planting as described by Mr. Edwards. The quantity of land intended to be planted, being cleared of weeds and other incumbrances, is divided into several plats of certain dimensions, commonly from fifteen to twenty acres each; the spaces between each plat or division are left wide enough for roads, for the conveniency of carting, and are called *intervals*. Each plat is then subdivided, by means of a line and wooden pegs, into small squares of about three feet and a half. The Negroes are then placed in a row in the first line, one Negro to a square, and directed to dig out with their hoes the several squares, commonly to the depth of five or six inches, the mould which is dug up being formed into a bank at the lower side; the excavation or cane hole seldom exceeds fifteen inches in width at the bottom, and two feet and a half at the top. The Negroes then fall back to the next line, and proceed as before. Thus the several squares between each line are formed into a trench of much the same dimensions with that which is made by the plough. An able Negro will dig from sixty to eighty of these holes for his day's work of ten hours, and nearly double that number if the land has been previously ploughed and lain fallow.

The cane holes or trench being now completed, the cuttings are selected for planting, two of which are sufficient for a hole of the dimensions described, and each cutting should contain five or six germs. These, being placed longitudinally, in the bottom of the hole, are covered with mould about two inches deep, the rest of the bank being intended for future use. In twelve or fourteen days the young sprouts begin to appear; and as soon as they rise a few inches above the ground, they are, or ought to be, carefully cleared of weeds, and furnished with an addition of mould from the bank. This is usually performed by the hand. At the end of four or five months the banks are wholly levelled, and the spaces between the rows carefully hoe-ploughed. The lateral suckers which spring up after the canes begin to joint, should be removed, as they seldom come to maturity, and draw nourishment from the original plant.

The best season for planting, according to the observations of Mr. Edwards, is in the interval between August and the beginning of November. By having the advantage of the autumnal seasons, the young canes become sufficiently luxuriant to shade the ground before the dry weather sets in. Other seasons, it appears, are not so advantageous for the growth of the crop, as the plants will be more liable to be injured by the heavy rains and high winds with which the West India islands are so frequently visited.

All the precautions, however, which can possibly be taken by the most experienced planter will not always secure a crop. "The sugar cane," says Mr. Edwards, "is subject to a disease which no foresight can obviate, and for which human reason has hitherto, I fear, attempted in vain to find a remedy. This calamity is called the *blast*; it is the *aphis* of Linnæus, and is distinguished into two kinds, the black and the yellow, of which the latter is the most destructive. It consists of myriads of little insects, invisible to the naked eye, whose proper food is the juice of the cane; in search of which they wound the tender blades, and consequently destroy the vessels. Hence the circulation being impeded, the growth of the plant is checked, until it withers or dies in proportion to the degree of the ravage."

These insects are not the only enemies which the planters have to complain of; the canes are likewise destroyed by monkeys and rats, which are indeed more easily removed, but nevertheless frequently do a great deal of damage. The upland plantations in particular, suffer severely from monkeys: these creatures, which now abound in the mountainous parts of St. Christopher's, were supposed to be first brought thither by the French, when they possessed half that island. They come down from the rocks in silent parties in the night, and having posted sentinels to give the alarm if any thing approaches, they destroy incredible quantities of the cane by their gambols as well as their greediness. It is in vain to set traps for these creatures, however baited; and the only way to protect the plantations and destroy them, is to set a numerous watch, well armed with fowling-pieces and provided with dogs. The Negroes, who are very fond of *monkey shooting*, and who esteem their flesh a delicacy, are always ready to perform this part of their service.

In the lowland plantations the rats do a vast deal of mischief by destroying the canes. They are said to have been introduced from Europe by the shipping, and have since multiplied prodigiously, breeding in the ground under loose stones and bushes. These, like the monkeys, serve the field Negroes for food, and are even said to be sold publicly in the markets of Jamaica.

The canes are cut in our islands towards the end of February, or in March and April, as at this season they are as ripe as the nature of the soil will allow them to be. The quantity of sugar yielded by their juice, will be always in proportion to the dryness of the season, and this is the reason why in January four hundred gallons of juice commonly yield, upon an average, forty-eight gallons of sugar and molasses; in February from fifty-six to sixty-four; in March from sixty-four to seventy-two; and in April sometimes eighty.

But we must now return to Mr. Edwards, who, after he has given an account of the different manures which are laid upon the land to promote the vegetation of the plants, conducts us from the field into the boiling-house, where the process which converts the juice into a solid mass is fully explained. The nutritive quality of sugar, which has long been acknowledged, is strikingly apparent amongst the working Negroes, and the different animals employed upon our plantations. They thrive exceedingly from a free use of the cane-juice; and such is the pleasure they derive from it, that the time of crop in the sugar islands is the season of gladness and festivity both to man and beast. "So palatable, salutary, and nourishing is the juice of the cane," says Mr. Edwards, "that every individual of the animal creation derives health and vigour from its use. The meagre and sickly among the Negroes exhibit a surprising alteration in a few weeks after the mill is set in action. The labouring horses, oxen, and mules, though almost constantly at work during this season, yet, being indulged with plenty of the green tops of this noble plant, and some of the scummings from the boiling-house, improve more than at any other period of the year. Even the pigs and poultry fatten on the refuse. In short, on a well regulated plantation, under a humane and benevolent director, there is such an appearance during crop time, of health, plenty, and busy cheerfulness, as to soften in a great measure the hardships of slavery, and induce the spectator to hope, when the miseries of life are represented as insupportable, that they are sometimes exaggerated through the medium of fancy."

The juice is expressed from the sugar canes by mills constructed for the purpose, and worked either by wind, water, or cattle. The juice which flows from these machines generally contains eight parts of water, one part of sugar, and one part of gross oil, or mucilaginous gum, with a portion of essential oil. These are the mean proportions, and are subject to variation according to the different richness of the juice.

The process for obtaining the sugar is thus conducted: the juice or liquor runs from the receivers to the boiling-house, along a wooden gutter lined with lead. In the boiling-house it is received into one of the copper pans or cauldrons provided for that purpose, and called clarifiers. Of these there are commonly three; and their dimensions are generally determined by the power of supplying them with liquor. In these vessels the liquor, when clarified, is drawn off *at once*, and they are cleansed each time before they are used. Particular stress is laid upon the necessity of clarifying the cane-juice as soon as possible after it passes from the mill, since the purest will not remain twenty minutes in the receiver without fermenting. The great difficulty in sugar-making is to get rid of the superabundant acid; and this is generally effected by alkali or lime, the quantity of which must be varied according to the quality of the liquor. The juice is not suffered to boil, and the requisite degree of heat is ascertained by the rising of the scum into blisters, which break out into a white froth; and this generally happens when the liquor becomes within a few degrees of the temperature of boiling water. A damper adapted to the clarifier is applied, as soon as the appearances above mentioned have taken place, and the fire extinguished; after which the liquor is suffered to remain undisturbed for an hour (if circumstances will permit), and during this interval the greater part of the impurities will rise to the surface in scum, which will sink down unbroken when the juice is drawn off from the clarifier. This operation is managed either by a syphon, or a cock at the bottom of the vessel, from whence the liquor is received into a gutter, or channel, that conveys it to the evaporating boiler, commonly called the *grand copper*; and if originally produced from good and untainted canes, will now appear almost, if not perfectly, transparent.

In this copper the liquor is suffered to boil; and, as the scum rises, it is continually removed until the liquor grows finer and somewhat thicker. After being sufficiently reduced in quantity, it is laded into a second copper, where the boiling and scumming is renewed; and if the liquor is not so clear as is expected, lime-water is thrown into it. The criterion by which they judge that the subject in the second copper is going on well, is when the froth in boiling rises in large bubbles, and is but little discoloured. When the contents of the second have been considerably reduced by evaporation, they are removed to a third, and from that to a fourth and last, where the liquor becomes exceedingly thick, and from whence it is laded into the cooler. This is a shallow wooden vessel about eleven inches deep, seven feet in length, and from five to six feet wide. There are commonly six of these coolers, each of which will hold a hogshead of sugar. In these, the liquor as it cools begins to assume a solid form, and runs into a coarse irregular half-crystallized mass, separating itself from the molasses.

From the cooler it is carried into the curing-house, where we shall follow it, after having mentioned the mode by which the negroes ascertain the proper time for lading the liquor from the last copper into the cooler. "Many of the negro boilers," says Mr. Edwards, "guess solely by the eye, (which by long habit they do with great accuracy,) judging by the appearance of the grain on the back of the ladle; but the practice most in use is to judge by what is called the *touch*; i. e. taking up with the thumb a small portion of the hot liquor from the ladle, and, as the heat diminishes, drawing with the fore finger the liquid into a thread. This thread will suddenly break, and shrink from the thumb to the suspended finger, in different lengths, according as the liquor is more or less boiled. The proper boiling height for strong muscavado sugar is generally determined by a thread of a quarter of an inch long. It is evident that certainty in this experiment can be attained only by long habit, and that no verbal precepts will furnish any degree of skill in a matter depending wholly on constant practice."

The curing-house, where the business of sugar-making is completed, is described as a large airy building, provided with a large molasses cistern; over which there is a frame of massy joist-work without boarding. Upon these joists are ranged a number of empty hogsheads without headings, and having several holes bored in their bottoms, through each of which is thrust the stalk of a plantain leaf. Into these hogsheads the négroes put the mass from the cooler; and this part of the operation is called *potting*. Here the mass remains for two or three weeks, during which time the molasses drains through the spongy plantain stalks, leaving the sugar tolerably dry. This is the whole of the process, and sugar thus obtained goes by the name of *muscavado*, or raw sugar.

# TEFF.

TRIANDRIA DIGYNIA.

GENERIC CHARACTER.

Calyx bivalve, tapering to a point.
Corolla bivalve; valves egg-shaped, rather acute, and somewhat longer than the calyx.
Seed single, oblong, compressed, tapering at each end.

SPECIFIC CHARACTER.

Poa Abyssinica. P. panicula capillari laxa erecta, spiculis quadrifloris lævibus lineari-lanceolatis, foliis glabris subconvolutis. *Linn. Spec. Plant. Willd.* 1. p. 394. no. 31.

Panicle erect, loose, and hair-like. Spiculæ four-flowered, smooth, and linear lanceolate; leaves somewhat convoluted.

P. panicula patula, spiculis oblongis, circiter quinque-floris, culmo geniculato, inferne procumbente ramoso. *Jacq. Icon. Rar.* 1. pl. 17. *Misc.* 2. p. 364.

Teff. . . . . *Bruce's Travels,* 7. p. 184. 8vo. ed. *Edw. Germ.* 5. p. 84. pl. 24.

This is an annual plant, and, as its specific name imports, a native of Abyssinia. It rises to the height of two or three feet, and produces a prodigious number of small seeds, which, notwithstanding their minuteness, are equivalent to double or triple the quantity found in an ear of wheat. The Abyssinians eat this grain either whole, like rice, or ground into flour. The teff produces its seeds in less than two months after it is sown; and, in favourable seasons, the inhabitants will make three or four harvests in a year. Attempts have been made to raise the teff in the southern parts of France, from seeds brought from Abyssinia by Mr. Bruce, but without success.

We are indebted to Mr. Bruce for the most circumstantial account of the teff; and as his description tends in some degree to illustrate the manners of the Abyssinians, we shall take the liberty to subjoin it in his own words.

"This grain is commonly sown all over Abyssinia, where it seems to thrive equally on every sort of ground; from it is made the bread which is commonly used throughout Abyssinia. The Abyssinians, indeed, have plenty of wheat, and some of it of an excellent quality. They likewise make as fine wheat-bread as any in the world, both for colour and for taste; but the use of wheat-bread is chiefly confined to people of the first rank. On the other hand, teff is used by all sorts of people, from the king downwards; and there are kinds of it which are esteemed fully as much as wheat. The best of these is as white as flour, exceedingly light, and easily digested. There are others of a brownish colour, and some nearly black; this last is the food of soldiers and servants. The cause of this variation of colour is manifold; the teff that grows on light ground having a moderate degree of moisture, but never dry; the lighter the earth is in which it grows, the better and whiter the teff will be; the husk too is thinner. The teff, too, that ripens before the heavy rains is usually whiter and finer; and a great deal depends upon sifting the husk from it, after it is reduced to flour, by bruising or breaking it in a stone mill. This is repeated several times with great care, in the finest kind of bread, which is found in the houses of all people of rank or substance. The manner of making it is by taking a broad earthen jar, and having made a lump of it with water, they put it into an earthen jar, at some distance from the fire, where it remains till it begins to ferment or turn sour; they then bake it into cakes of a circular form, and about two feet in diameter. It is of a spongy soft quality, and a sourish, not disagreeable taste. Two of these cakes a day, and a coarse cotton cloth once a year, are the wages of a common servant.

“ At their banquets of raw meat, the flesh, being cut in small bits, is wrapped up in pieces of this bread, with a proportion of fossil salt, and Cayenne pepper. Before the company sits down to eat, a number of these cakes, of different qualities, are placed one upon the other, in the same manner as our plates; and the principal people, sitting down first, eat the white teff; the second, or coarser sort, serves the second-rate people that succeed them; and the third is for the servants. Every man, when he has done, dries or wipes his fingers upon the bread which he is to leave for his successor; for they have no towels; and this is one of the most beastly customs of the whole.

"The teff-bread, when well roasted, is put into a large jar, after being broken into small pieces, and warm water poured upon it. It is then set by the fire, and frequently stirred for several days, the mouth of the jar being close covered. After being allowed to settle for three or four days, it acquires a sourish taste, and is what they call *bouza*, or the common beer of the country. The bouza in Atbarra is made in the same manner; only, instead of teff, cakes of barley-meal are employed: both are very bad liquors, but the worst is that made of barley."

Having thus described the use of teff-bread, Mr. Bruce proceeds to give a botanical description of the plant, and to venture a conjecture respecting the knowledge which the antients had of the grain. For this part of the account we must beg leave to refer our readers to his Travels.

# COFFEE.

## PENTANDRIA MONOGYNIA.

### GENERIC CHARACTER.

Calyx five-toothed, small.
Corolla a salver-shaped petal, divided into five parts.
Seed-vessel nearly round, and containing two seeds.

### SPECIFIC CHARACTER.

COFFEA ARABICA. C. foliis oblongo-ovatis acuminatis, pedunculis axillaribus aggregatis, corollis quinquefidis. *Linn. Spec. Plant. Willd.* 1. p. 973.

Leaves of an oblong-ovate shape, and terminating in a point: flower-stalks axillary, and collected together in small branches: corolla divided into five parts.

Jasminum arabicum lauri folio, cujus semen apud nos Coffe dicitur. *Juss. Act.* 1713. p. 388. t. 1.

Euonyno similis ægyptiaca, fructu baccis lauri simili. *Pluk. Phyt.* 272. f. 1.

BON. *Alp. Ægypt.* 36. t. 36.

COFFEE. . . . *Blackw. Herb.* t. 337. *Ellis's History of the Coffee-tree.*

THERE are several species belonging to this genus; but the one we have chosen is by far the most celebrated, and the best deserving our attention. This tree is of great service to mankind, since its cultivation affords employment to several thousands of our fellow-creatures, while its berry yields us a pleasant, wholesome, and invigorating beverage. Arabian coffee has obtained its name from the country where it was first noticed; for, at present, far from being confined to Arabia, it is cultivated in several parts of the world, and particularly in the West Indies.

The coffee-tree is an evergreen of quick growth, rising to the height of fifteen or twenty feet. It has a straight trunk of three or four inches in diameter, bearing a number of branches opposite to each other, furnished with oval entire leaves, somewhat resembling the common laurel. In the angles of these leaves appear little bunches, consisting of four or five white flowers, of an agreeable smell, and resembling the jasmin in figure. Each flower is supported upon a very short foot-stalk, and is composed of a monopetalous corolla, whose margin is cut into five divisions; five stamens, and a pistil having two stigmas, are included within the cup of the flower; the germen is an oval berry with an umbilicus containing two seeds, flat and furrowed on one side, convex on the other. It is unnecessary to remark, that these seeds, when dried and roasted, form the article so well known under the name of coffee.

Before we proceed to the mode of cultivation of this most useful plant, it may not be improper to trace its history, as far as relates to the use of its berry.

According to the Abbé Raynal, coffee came originally from Upper Ethiopia, where it has been known from time immemorial, and where it is still cultivated with success. From this and other parts of the Eastern world, very large quantities of coffee are annually exported to different European countries, and form a commercial article of considerable importance. It is said that we owe the discovery of coffee to the superior of an Arabian monastery, who gave his monks an infusion of the berry, that they might not sleep too sound, and forget their nocturnal prayers. The quality which coffee possesses of dissipating sleep is well known, and several persons are in the habit of taking it when on any particular occasion they are desirous of keeping awake during the night.

From the borders of the Red Sea, the use of coffee passed to Medina, to Mecca, and, by means of the pilgrims, into all the Mahometan countries. In an Arabian manuscript, however, which is in the National Library at Paris, it is said that coffee, although originally from Arabia the Happy, was known in Africa and in Persia long before the Arabians used it for domestic purposes. Towards the middle of the fifteenth century, the mufti of Aden, a city of Arabia, travelled into Persia, where he saw the liquor used, and upon his return taught his countrymen how to make the infusion. From

Aden (according to the same information) the use of coffee soon spread into every place that was subject to the laws of Mahomet.

After the use of coffee became generally known throughout the East, several houses were opened for the accommodation of the public, and were soon frequented by people of every denomination. In Persia the coffee-houses became, as with us, the resort of politicians and of men of business; affairs were there transacted with as much order and regularity as our commercial business is managed on the 'Change. This, however, was not the case in all parts; for at Constantinople the coffee-houses were no sooner opened than they became the haunt of the most disorderly inhabitants; and from the excesses committed by these people, the government, under Amurath the Third, thought fit to shut them up, and prohibit the use of coffee in any but private families. Notwithstanding the order to the contrary, coffee still continued to be drunk in public, and the places where it was distributed soon multiplied exceedingly. Under the minority of Mahomet the Fourth, the grand visir Koproli again suppressed the coffee-houses; but this, like the first attempt, proved ineffectual; the people were determined to be indulged, and their favourite liquor was not to be taken from them with impunity. The opposition of government therefore, without effecting its purpose, contributed only to raise dissensions amongst the people, and to diminish the revenues of the state. In the beginning of the sixteenth century, similar disturbances, on the same account, broke out at Cairo. In the year 1523, the 930th of the Hegira, Abdallah Ibrahim openly preached against the use of this liquor, in the mosques: this proceeding, as may readily be supposed, inflamed the people, and the parties came to blows; but the shiek El-belet, (commander of the city,) having assembled the doctors together, attended with great patience to a long harangue upon the subject; and after having agreed that coffee was an innocent beverage, and fit to be used all over the world, he dissolved the meeting, and thus wisely re-established tranquillity in the city. After this, the use of coffee was universally established throughout the East, where it still continues a favourite, notwithstanding the severity of the laws, and the austerity of religion, were once united to proscribe it.

In the reign of Soliman the Great, about the year 1554, coffee became an article of general use in Constantinople; and in about a century afterwards it was adopted both in London and Paris; but its introduction into England during the reign of Charles the Second, met with the same opposition that it had formerly experienced in Turkey under Amurath and Mahomet. It was found that coffee-houses served only to harbour the disorderly and seditious parts of the community; therefore, in the year 1675, the government thought fit to suppress them *. In France this matter was better conducted; the establishment of public places was peaceably maintained; and in 1669, Soliman-Aga, who resided a twelvemonth in Paris, taught several persons to drink coffee during his stay, who after his departure continued the use of it.

It is not surprising that a people like the French, who are naturally light and lively, should readily adopt a beverage which is so well calculated to support their spirits: they sought it with avidity; but at first, like all other rarities, it was confined to the opulent, and considered as an extraordinary luxury. At length, however, it became more common; its price decreased in proportion, and by degrees it came within the reach of every class of people throughout the country.

Arabia was formerly the quarter from whence all the coffee was imported: the introduction of the plant into other countries was a desideratum reserved for a nation well known for its persevering industry; the Dutch being the first who transported this tree from Mocha to Batavia, and from Batavia to Amsterdam. At the beginning of the eighteenth century, the magistrates of this last city sent a plant to Louis the Fourteenth, which was carefully nursed in the *Jardin des Plantes* at Paris, and may be considered as the father of all those which were

* The first coffee-house in this country was opened by one Jobson, a Jew, at Oxford, in the year 1650. Arthur Tillyard, apothecary, sold it publicly in his own house in 1655; and Jobson afterwards, in London, about the year 1671.

afterwards planted in the French West India islands. According to the account of a French author, Martinique was the first island that received the coffee-tree. It was carried there by M. de Clieux, who, during a long and laborious passage, in which the fresh water fell so short as to be distributed in portions to each passenger, shared his daily allowance with the plant which was under his care; and by this management succeeded in bringing it alive to the island of Martinique. Here a soil and situation the most favourable to its growth was decided on; the tree carefully attended till it produced its fruit, and the seeds distributed to the different inhabitants of the island, with directions for their cultivation. All the success that could be expected attended their endeavours; the plants multiplied exceedingly; and after a few years were transported from Martinique to St. Dominique, to Guadaloupe, and to the other neighbouring islands. About this time, or a little after, the coffee-plant was introduced into Cayenne by a Frenchman, who brought the fresh seeds from Dutch Guiana. In the year 1717, the French East India Company sent some of the Mocha coffee to the island of Bourbon; from whence all the plants which have since been cultivated there are descended, and the berries gathered from them are known in commerce by the name of Bourbon coffee.

The coffee-tree succeeds very well in all those countries which are situated either within, or in the neighbourhood of, the tropics. We have already noticed that it has been successfully introduced into the West Indies, as well as into other islands; though at the same time it must be acknowledged, that the best coffee is produced in Arabia. We learn from the Abbé Raynal, that 12,550,000 pounds weight are annually exported from Arabia; of which about 3,500,000 pounds are bought by the different European companies. It is principally in the kingdom of Yemen, towards the districts of Aden and of Mocha, that the coffee-plant is cultivated on a large scale. A certain quantity of water seems highly necessary for the welfare of this tree; and the Arabs, probably to confine the moisture from evaporating, are in the habit of throwing stones into the trenches which are dug for the plants: the principal care required to ensure the success of a coffee plantation appears to consist in conducting a sufficient quantity of water to the foot of the tree: the fruit is gathered at three different times, but the chief gathering is in May. At this season of the year the Arabs spread pieces of cloth under the coffee-trees, in order to catch the fruit, which readily falls to the ground when the trees are shaken. After the crop has been thus collected it is placed on mats to dry, and the capsules forced open by passing over them a very heavy stone, or cylinder of wood. When the seeds have been thus divested of their covering, and separated into the little convex beans, they are stirred about in great winnowing-fans, in order to cleanse them; and finally dried again.

Such is the simple and easy method employed by the Arabs in the cultivation of this interesting tree, and in the gathering and preservation of its fruit.

In the West Indies it is usual to arrange the coffee plants at the distance of about eight feet from each other, and to top them when they are six or seven feet high. The negroes employed in a coffee plantation prepare to pick the berries as soon as they assume a blackish colour; and each negro, for this purpose, is provided with a canvass bag, having a hoop in the mouth of it to keep it open. This bag is hung about the neck of the picker, who empties it, as often as it is full, into a basket. The usual practice is to pick the trees at three different stages of their ripeness, and we are told that one hundred bushels in the pulp, fresh from the tree, will yield about a thousand weight of merchantable coffee. After the coffee is collected it is spread out in the sun to dry, in layers of about five inches deep; and when this is accomplished, the husks are separated from the seeds, either by a grinding-mill, or with pestles in troughs, or large wooden mortars.

Although this tree is a native of the warmer parts of Asia and of Africa, yet it is said to have succeeded in the temperate parts of Europe. In the botanic garden at Pisa M. Telli has raised a coffee-tree which has produced ripe fruit every year, and from which he has obtained more than twenty other plants. These have been distributed to different parts of Italy; and he observes that no great degree of heat is necessary for their preservation, since, during the winter, a temperature of from thirteen to fifteen degrees of Reaumur's thermometer (*i. e.* from about 60 to 66 of Fahrenheit) will be sufficient to preserve the plants alive.

The inhabitants of the East are so fond of coffee, that with them it may be considered as the principal beverage. They are in the habit of taking three or four ounces in the course of the day, without either milk or sugar, but perfumed with cloves, cinnamon, cummin seeds, or essence of amber. The Persians roast their coffee with the capsule that covers the berries, and mix the whole together when they prepare their infusion; and this they are persuaded is a better method than the common one of preparing it with the berries alone. The Turks occasionally make a decoction of the berries, before they are roasted, and drink it with a small quantity of sugar, in order to strengthen the stomach and promote an appetite.

It may not be improper to remark, that good coffee should be small, perfectly dry, difficult to crush between the teeth, of a light yellowish colour, and of a strong but pleasant smell. It matters little whether the coffee be old or new, provided it has been gathered when perfectly ripe, and drunk soon after it is roasted. Much stress has been laid upon the superior excellence of the Mocha coffee, and, generally, we believe, with great justice; but a

French writer, who has resided for some years in the West Indies, tells us that he has tasted coffee in Saint Domingo, made from grain which had been gathered six weeks before, full as good, if not better, than that which was produced at Mocha, after it had been kept for two or three years. This coffee, however, he acknowledges, was gathered by himself, and prepared for the purpose with every requisite attention.

# VINE.

### PENTANDRIA MONOGYNIA.

#### GENERIC CHARACTER.

Calyx five-toothed.
Corolla of five small petals.
Seed-vessel a round pulpy fruit, containing five small seeds.

#### SPECIFIC CHARACTER.

VITIS VINIFERA. V. foliis sinuatis nudis. *Linn. Spec. Plant. Willd.* 1. p. 1180.
Leaves naked and sinuated.
Vitis, foliis palmato-angulatis. *Hort. Cliff.* 74.
VITIS VINIFERA. *Bauh. Pin.* 299.
VITIS CORINTHIACA sive APYRENA. *Bauh. Hist.* 2. p. 72.

COMMON VINE. . *Duham. Arb. Fruct.* 2. pl. 1.—6. *Blackw. Herb.* pl. 154.

THIS is the most important of all the different species of vine, being cultivated in several parts of the world for the sake of its luscious fruit. It would be needless to give a particular description of a plant with which every one is acquainted, or to detail the manner in which it is cultivated; nevertheless it may not be wholly uninteresting to trace its history, as far as relates to its introduction for the purpose of making wine.

The grape was transmitted from Asia to Europe; and the Phœnicians, who were early navigators, especially along the Mediterranean coast, transferred it to most of the isles, as well as to the continent. It succeeded to admiration in the islands of the Archipelago, and was afterwards introduced into Greece and Italy.

Pliny was persuaded, that the libations of milk instituted by Romulus, and Numa's prohibition to honour the dead by pouring wine on their tombs, made it evident that vines were very scarce in Italy at that time. The plant was multiplied in succeeding ages: a set of Gauls who had tasted its juice, formed a resolution to establish themselves in the countries that produced it; and instead of employing letters and exhortations to engage other Gauls in the intended expedition, they sent quantities of wine to all the adjacent parts; upon which the inhabitants of several provinces immediately quitted the acorns of their forests, and joined the main army. The Alps were insufficient to check their progress; and they extended their conquests along the two shores of the Po, where they applied themselves to the cultivation of the fig, the olive, and the grape in particular. Such was the motive to their enterprise; and instead of blaming our ancestors for having recourse to arms, in order to secure the enjoyment of wine, Pliny justifies their conduct, by alleging the purity of their intentions. It has likewise been thought that those Gauls, who established their settlements along the Po, transmitted to us the useful invention of preserving wine in wooden vessels exactly closed. Its preservation and transmission to distant parts became more practicable from that period than it could be before, when it was kept in earthen jars, that were easily shattered, or in skins which were liable to be unsewed, or to grow mouldy *.

The vine was introduced by the Romans into Britain, and appears formerly to have been very common. From the name of vineyard yet adhering to the ruinous sites of our castles and monasteries, there seem to have been few in the country but what had a vineyard belonging to them. The county ofGloucester is particularly commended by Malmsbury in the twelfth century, as excelling all the rest of the kingdom in the number and goodness of its vineyards. In the earlier periods of our history, the isle of Ely was expressly denominated the Isle of Vines by the Normans. Vine-

* To those who are unacquainted with the circumstance, it may not be improper to remark that it was customary in the early ages of the world to preserve wine in bottles made of skin, a specimen of which may be seen in the seventh volume of the Antiquities of Herculaneum, where a woman is pouring wine into a cup from the skin of an animal. The places where the legs had been are plainly visible; and the neck served for the passage of the liquor. This illustrates some passages of scripture; such as *Matt.* ix. ver. 17. "Neither do men put new wine into old bottles, else the bottles break, and the wine runneth out, and the bottles perish."

yards are frequently noticed in the descriptive accounts of Doomsday; and those of England are even mentioned by Bede as early as the commencement of the eighth century. Doomsday presents to us a particular proof that wine was made in England during the period preceding the conquest; and after the conquest the bishop of Ely appears to have received at least three or four tuns of wine annually, as tithes, from the produce of the vineyards in his diocese; and to have made frequent reservations in his leases of a certain quantity of wine for rent. A plot of land in London, which now forms East Smithfield and some adjoining streets, was withheld from the religious house within Aldgate, by four successive constables of the Tower, in the reigns of Rufus, Henry, and Stephen, and made by them into a vineyard, to their great emolument and profit. In the old accounts of rectorial and vicarial revenues, and in the old registers of ecclesiastical suits concerning them, the tithe of wine is an article that frequently occurs in Kent, Surry, and other counties.

The inhabitants of Marseilles and Narbonne had some vines when Gaul was conquered by Julius Cæsar, but the progress of their cultivation was prohibited by Domitian; and the Gauls, as well as the Britains and Spaniards, were not permitted to plant them till the reign of that excellent emperor Probus. He was sensible that the promotion of agriculture ought to be inseparable from a good government; and that the reign of a prince can never be propitious, unless he be sedulous to procure plenty and tranquillity to the people of whom he is constituted father. The plantation of vineyards in Brittany, in the northern part of the Celtic provinces, was attended with unsurmountable difficulties on the part of Nature; and the inhabitants of those countries, and even of Celtic Gaul, continued to extract their usual drink from barley, for want of a sufficient growth of vines:

> "Unthriving vines compell'd the Celtic swain
> To force a liquor from the bearded grain."

But at last they were planted in all countries where there was any possibility of their success. It was in the seventh century that they began to be propagated through all France; and they probably invited the Franks into Gaul, as they had already engaged the Gauls to fix their settlements in Italy. The other German nations, who had no more conquests to pursue, endeavoured to open a tract of land in the Black Forest, and to plant vines along the banks of the Rhine. Hungary had likewise its vineyards; and when they afterwards were propagated in all parts, the inhabitants grew satisfied with their condition, and were no longer solicitous to secure new settlements.

The Romans, even nearly to the days of Lucullus, were very seldom able to regale themselves with wine. Very little was then raised in the compass of Italy; and the foreign wines were so dear that they were rarely produced at an entertainment;

and when they were, each guest was indulged only with a single draught. But in the seventh century of Rome, as their conquests augmented the degree of their wealth, and enlarged the sphere of their luxury, wines became the object of particular attention. Many vaults were constructed, and good stocks of liquor deposited in them; and this naturally gave encouragement to the wines of the country. The Falernian rose immediately into great repute; and a variety of others, that of Florence among the rest, succeeded it about the close of the century. Thus were the more westerly parts of the European continent at once subjected to the arms, and enriched with the vines, of Italy.

The climate of China is well calculated to forward the growth of this plant; and accordingly, abundance of grapes are produced in that country. It is not therefore for the want of this fruit that the Chinese neglect the use of wine; and the notion, which has long prevailed, that the vine was recently introduced into this empire from the West, appears to be erroneous. From the information which the Abbé Grosier obtained relating to this plant, we learn that the vine has been known and cultivated in China from the remotest antiquity. It has, nevertheless, experienced many revolutions since its first introduction into that extensive empire, and has never been excepted, when orders have been issued for rooting up all the trees that encumbered the fields destined for agriculture. The extirpation of the vine has been even carried so far in most of the provinces, under certain reigns, that the remembrance of it has been entirely lost. When it was afterwards allowed to be planted, it would appear, from the manner in which some historians express themselves, that grapes and the vine began then to be known for the first time; this probably has given rise to the opinion that the vine has not been long introduced into China. "It is, however, certain," says the Abbé Grosier, "without speaking of remote ages, that the vine and grapes are expressly mentioned in the Chinese annals, under the reign of the emperor *Vou-ty*, who came to the throne in the year 140 before Christ; and that from his time the use of wine may be traced from reign to reign even to the fifth century.

"The songs," says Grosier, "which remain of all the dynasties since that of *Yven* to *Han*, give us reason to believe that the Chinese have always been fond of wine made from grapes. The emperor *Ouenti*, of the dynasty of *Ouei*, celebrates it with a lyric enthusiasm worthy of Horace or Anacreon; and we find in a large Chinese herbal, book 133, that wine made from grapes was the wine of honour, which several cities presented to their governors and viceroys, and even to the emperor. In 1373, the emperor *Tai-tsou* accepted some of it for the last time, from *Tai-yuen*, a city of *Chen-si*, and forbade any more to be presented. 'I drink little wine,' said the prince, 'and I am unwilling that what I do drink should occasion any burthen to my people.'"

To enter into a detailed account of the manner of cultivating the vine would fill a volume; we shall therefore merely remark, that it succeeds best between the fortieth and fiftieth degree of latitude, within which space we find all those vineyards whose produce has been so highly extolled. France has long been famed for producing this plant in its greatest perfection; and it is well known that most of our finest wines are imported from that country.

# SWEET GRASS.

**PENTANDRIA DIGYNIA.**

GENERIC CHARACTER.

An umbel of many spokes, supporting a bunch of flowers, of which those near the centre have five equal petals, while those in the circumference are divided into five unequal petals, the outer divisions being the largest.

Seeds two, egg-shaped and compressed.

SPECIFIC CHARACTER.

| | |
|---|---|
| HERACLEUM PANACES. | H. foliis pinnatis; foliolis quinis; intermediis sessilibus, floribus radiatis. *Linn. Spec. Plant. Willd.* 1. p. 1423. no. 6. |
| | Leaves pinnated; leaflets in fives; flowers radiated. |
| | H. foliis pinnatifidis. *Gmel. Sibir.* 1. p. 213. |
| SWEET-GRASS. . . . | *Penn. Arct. Zool.* (introduct.) p. 117. |

THIS species of Heracleum deserves to be noticed on account of the use which one of our rude northern nations, the Kamtschatkans, make of it. These people regard the plant as one of the most precious that their country affords: it formerly entered into the composition of all their dishes. They eat the leaves as a sweet and agreeable food. Since the Russians have come amongst them, however, this vegetable, which was once so wholesome and nourishing, is converted into a medium for inebriants, and the manner in which they proceed to extract a spirit from it is as follows:—The beginning of July the more succulent stalks and leaves are gathered, and this province falls principally to the share of the women, who gather the crop in gloves to defend their hands from the sap, which is so acrid as to blister the skin. After the down is scraped from the leaves and stalks, with a shell, they are laid to ferment; when they grow dry, they are placed in bags, and in a few days are covered with a saccharine powder: only a quarter of a pound of powder is obtained from a *pood*, or thirty-six pounds of the plant, which tastes like liquorice. They draw the spirit from it by steeping bundles of it in hot water; then promote the fermentation in a small vessel, by adding the berries of the *Lonicera Xylosteum* and *Vaccinium uliginosum* Linn. They continue the process by pouring on more water, after drawing off the first; they then place the plants and liquor in a copper still, and draw off, in the common manner, a spirit as strong as brandy. This liquor was discovered accidentally. One year the natives, happening to collect a greater quantity of berries of several kinds, for winter provisions, than usual, found in the spring that the principal part of them had fermented, and become useless as food. They resolved to try them as a drink; and their spirituous flavour proving agreeable, they were induced, with the assistance of the Russians, to try the effect of distillation. The experiment succeeded; and a spirit was produced, which, according to Steller, throws those that drink it into a melancholy, especially if the stalks of the plant from which it is made have not been well scraped. Those therefore who are unaccustomed to this liquor, and would wish to avoid night-mare, and great debility, must be cautious how they drink it. There is a great singularity attending the use of this spirituous liquor; for it is said that persons who have made too free with it over night, and have drunk cold water the next day, have been a second time intoxicated, and felt a return of those symptoms which Steller remarks as peculiar to this beverage.

There are several species belonging to this genus, though only one of them is common in this country. The cow parsnip (*Heracleum spondilium*) is sufficiently abundant in woody situations, where it grows to the height of four or five feet. The leaves are winged, and the whole plant is harsh and rough.

As this plant spreads considerably by its roots, especially in places that afford an earth congenial to its nature, it is often necessary to stop its progress; and this is best done by cutting down the stalk when the flowers just begin to blow.

# VARNISH TREE.

## PENTANDRIA TRIGYNIA.

### GENERIC CHARACTER.

Calyx quinque-partite.
Corolla of five oval petals.
Seed-vessel, a roundish berry containing a single seed.

### SPECIFIC CHARACTER.

RHUS VERNIX. R. foliis pinnatis integerrimis annuis opacis, petiolo integro æquali. *Linn. Spec. Plant. Willd.* 1. p. 1479.

With pinnated leaves of a dark colour, and renewed annually: leaf-stalks equal and entire.

TOXICODENDRON CAROLINIANUM. Foliis pinnatis, floribus minimis herbaceis. *Duhamel, Traité des Arbres,* 2. p. 342. pl. 99.

ARBOR VENENATA. *Kalm. It.* 2. p. 211.

VARNISH TREE. *Dill. Elth.* pl. 292. f. 377. *Pluk. Alm.* pl. 145. f. 1. *Kæmph. Amœn.* pl. 792.

THE Varnish tree is a native both of Japan and of the northern parts of America. It flowers in July, and produces a fine effect in autumn, on account of its leaves, which, at that time, turn of a purple colour, and form a striking contrast with the neighbouring foliage. Like another species of this genus, its juice is of a poisonous nature; and Adanson tells us that its exhalations affect the skin, and cause red spots to make their appearance as in erysipelas. This author likewise says, that if the leaves are touched in the slightest manner, and the fingers afterwards carried to the eyes or the mouth, very unpleasant effects will be produced. This poisonous quality in the varnish tree is also mentioned by Mr. Dudley in the Philosophical Transactions. He describes the tree as growing in the marshy grounds of America, and informs us that the inside of the wood is yellow, and full of a thick glutinous juice, which has a very rank and disagreeable smell.

The scent only of this tree, when cut down in the woods, or burnt in the fire, has affected some persons very materially. The following instances by Mr. Dudley, which we shall relate in his own words, will be sufficient to give some idea of the nature of this vegetable poison. "One of my neighbours was blind for above a week together with only handling it; and a gentleman in the country, sitting by his fire-side in the winter, was swelled for several days with the smoke or flame of this wood. It has this effect only on some particular persons and constitutions; for I have seen my own brother not only handle but chew it without any harm at all. And by the same fire one is poisoned, while another is not at all affected. However, this poison is never mortal, but goes off in a few days of itself; yet generally we apply plantain water, or salad oil and cream. As to its operation, within a few hours after the person is poisoned he feels an itching pain that provokes scratching, which is followed by an inflammation and swelling; sometimes a man's legs only have been poisoned, and have run with water. My neighbour, that was so sadly poisoned with handling it, told me one thing very remarkable; and that is, that, when he touched it, he plainly perceived it to differ from the other wood that he was throwing into his cart, by its being as cold as a piece of ice; and withal assured me, that he could distinguish it blindfold, from any other wood in the world, by its coldness; but the poor man is as much afraid of it when he goes into the woods as of a rattle snake. He further tells me, that he felt an itching in a few hours after he had handled the wood, but the swelling did not come on till about three days after."

It is from this tree that the Japanese obtain a kind of varnish with which they blacken their different utensils. In order to collect the varnish, they make a number of incisions in the tree, from whence there flows a white and viscous liquor, which they receive into wooden vessels, and which blackens upon being exposed to the air. This they preserve in jars covered with oiled skin.

But the Japan varnish is very inferior to what the Chinese obtain from a tree known in the country by the name of *Tsi-chu.* As this is possessed of similar properties with the preceding, it will not be improper to describe it under the same head.

The bark and leaves of the *tsi-chu* resemble those of the ash; and the trunk (which, when full grown, is about two feet in circumference,) seldom exceeds twelve or thirteen feet in height. The method which the Chinese take to propagate this tree, and the manner in which they afterwards collect their varnish from it, is so well told by the abbé Grosier, that we shall beg leave to avail ourselves of his description.

"In spring," says Grosier, "they (the Chinese) choose a vigorous shoot, about a foot in length, which proceeds immediately from the trunk; and coat over the lower part, by which it adheres to the tree, with a kind of yellow earth, at least three inches in thickness. This coat is carefully covered with a mat, to defend it from rain and the injuries of the air. Towards the autumnal equinox, they detach a little of the earth, to observe in what condition the small roots are, which begin to spring forth from the shoot. If they find that the filaments which compose them are of a reddish colour, they judge it is time to make an amputation; but they defer it if the roots are white, because this colour shows that they are yet too tender. They then close up the coat again and wait till the spring following. When the shoot is separated from the trunk of the tree, it is put into the earth; but, in whatever season it is planted, whether in spring or autumn, great care must be taken to put plenty of cinders into the hole prepared for it; without this precaution the ant would destroy the yet tender roots, or, at least, deprive them of all their moisture, and cause them to decay.

"The Chinese do not procure varnish from the *tsi-chu* until its trunk is nearly five inches in diameter, which it seldom attains before seven or eight years. Varnish extracted from a tree smaller, or of less age, would not have the same body and splendour. This liquor distills only in the night time and during the summer season; it does not flow in winter; and the varnish produced by the tree in spring or autumn is always mixed with a great deal of water. To cause the gum to flow, they make several rows of incisions round the trunk, the number of which is proportioned to the vigour of the tree. The first row is seven inches from the earth, and the rest are at the same distance one from the other, and continue to the top of the trunk, and even sometimes on the boughs which are of a sufficient strength and size. The Chinese use a crooked iron for making these incisions, which must run a little obliquely, and be equal in depth to the thickness of the bark; they make them with one hand, and with the other hold a shell, the edges of which they insert into the opening, where it remains without any support. These incisions are made towards evening, and next morning they collect the varnish that has fallen into the shells; the following evening they are again inserted; and the operation is continued till the end of the summer. A thousand trees yield almost, in one night, twenty pounds of varnish. This varnish, for the most part, is not extracted by the proprietors of those trees, but by merchants, who purchase them for the season, at the rate of three-pence per foot. These merchants afterwards hire workmen, to whom they give an ounce of silver per month both for their labour and maintenance. One workman is sufficient for fifty feet of timber.

"While the varnish distills, it exhales a malignant vapour, the bad effects of which can only be prevented by preservatives and great precaution. The merchant who employs these workmen is obliged to keep by him a large vase filled with rape-oil, in which a certain quantity of those filaments have been boiled that are found in hog's lard, and which do not melt. When the workmen are going to fix the shells to the trees, they carry some of this oil along with them, and rub their face and hands with it, which they do with greater care when they collect, in the morning, the varnish that has distilled during night. After eating, they wash their whole bodies with warm water in which the bark of the chestnut-tree, fir-wood, crystallized saltpetre, and some other drugs, have been boiled. When they are at work near the trees, they put upon their heads a small cloth bag, in which there are two holes, and cover the fore part of their bodies with a kind of apron made of doe-skin, which is suspended from their necks with strings, and tied round them with a girdle. They also wear boots, and have coverings on their arms made of the same kind of skin. The labourer who should attempt to collect varnish without using this precaution, would soon be punished for his rashness; and the most dreadful effects would ensue. The disorder shows itself by tetters, which become of a bright red colour, and spread in a very short time; the body afterwards swells, and the skin bursts, and appears covered with an universal leprosy. The unhappy wretch could not long endure the excruciating pains which he feels, did he not find a speedy remedy in those preservatives which are used against the malignant and noxious exhalations of the varnish.

"When the labourers go to collect this gum, they carry, suspended from their girdles, a kind of vessel made of leather: with one hand they detach the shells, and scrape them with a small iron instrument, which they hold in the other, in order that they may lose none of the varnish. It is then carried to the merchant's house, where it is purified by straining it through a cloth; and the dregs are sold to the druggists, who employ them for certain purposes in medicine.

"The season of collecting varnish being ended, the merchant puts it into small casks closely stopped. A pound of it, newly made, costs him about one shilling and eightpence sterling; but he gains cent. per cent. upon it, and sometimes more, according to the distance of the place to which he transports it."

ALOE.

*Designed by W. Daniell.*

*Published by Mess.rs Cadell & Davies, London, March 1, 1807.*

# ALOE.

### HEXANDRIA MONOGYNIA.

#### GENERIC CHARACTER.

Calyx none.

Corolla a single petal divided on its border into six equal parts.

Capsule oblong, triangular, and divided into three partitions.

Seeds numerous.

#### SPECIFIC CHARACTER.

| | |
|---|---|
| AGAVE AMERICANA. | A. acaulis, foliis dentato-spinosis, scapo ramoso, tubo corollæ medio angustato, staminibus corolla longioribus, stylo staminibus longiore. *Linn. Spec. Plant. Willd.* 2. p. 192. |
| | Stemless; leaves toothed and thorny; flower-stem branched; stamens longer than the corolla, which has a narrow tube; style longer than the stamens. |
| | A. acaulis, foliis dentato-spinosis. *Ait. Hort. Kew.* 1. p. 471. |
| | A. scapo arboreo ramoso. *Hall. Helv.* no. 1249. |
| AMERICAN ALOE. | *And. Bot. Rep.* pl. 348. |

THE glorious appearance which this plant makes, during the time it is in flower, has justly excited the admiration of naturalists. Its tall stem and large head of blossom, which, to make it a still greater object of curiosity, is said to appear but once in a century, are well calculated to attract our attention, as we meet with nothing amongst the plants of our northern climate to equal it in grandeur. The aloe is a native of all the southern parts of America, and has been introduced into several parts of Europe: the stem generally rises upwards of twenty feet high, and branches out on every side towards the top, so as to form a kind of pyramid. The slender shoots are garnished with greenish yellow flowers, which come out in thick clusters at every joint, and continue long in beauty; a succession of new flowers being produced for near three months in favourable seasons, if the plant is protected from the autumnal colds. The elegance of the flower, and the rarity of its appearance in our cold climate, renders it an object of such general curiosity, that the gardener who possesses the plant, announces it in the public papers, and builds a platform around it for the accommodation of the spectators. The popular opinion that the aloe never flowers but once in a century, and that its blooming is attended with a noise like the report of a cannon, are equally without foundation; the fact is, that the time which this plant takes to come to perfection varies with the climate. In hot countries, where they grow fast and expand many leaves every season, they will flower in a few years; but in colder climates, where their growth is slow, it will be much longer before they arrive at perfection.

The leaves of the American aloe are five or six feet long; from six to nine inches broad, and three or four thick. They are formed of a mucilaginous fluid, surrounding an immense quantity of parallel threads, which, when separated, and properly manufactured, serve the purpose of hemp, being used for cordage, and to make packing-cloths. The leaves are always employed in America in this manner; and it is not long ago that they used them for the same purpose in Spain. To extract their flax from the leaves they are passed through rollers, and afterwards washed and combed by the workmen.

The abbé La Pluche speaks of the aloe as a tree as tall as that which bears olives: he tells us, that under its bark are contained three sorts of wood; the first is black, solid and weighty; the second of a tawny colour, and as light as rotten wood; and the third, which is at the heart, has a strong but agreeable smell. "The first," continues the abbé, "is called *eagle-wood*, and is very scarce: the second, wood of Calambac; it is brought into Europe, and esteemed there as an excellent drug; it burns like wax, and, when thrown into the fire, diffuses an aromatic scent. The heart, which is called wood of Calambac, or Tambac, is more precious in the Indies than gold itself. It is used for perfuming habits and apartments, and is a cordial in fainting and paralytic fits. In this wood they likewise set some of the most precious jewels of the Indies. These are not the only advantages of our aloe: the leaves of the tree serve instead of slates, for covering houses; they are also formed into the shape of dishes and plates, and, when they have been well dried, may be used at table. When they are stripped of their nerves and fibres betimes, these are manufactured into a thread, used in the same manner as hemp. The points which rise on the branches serve for nails, darts, and awls, with which last the Indians pierce their ears, when they design to honour the devil by some extraordinary austerities. If any cavity be made in the tree by cutting out the buds, a sweet and vinous liquor flows from the wound in a prodigious abundance; it proves a very pleasant liquor, and after some time changes to an excellent vinegar. The wood of the branches is good to eat, and has the flavour of candied citron. The very roots are likewise useful, and ropes are frequently made of them. In a word, a whole family may be supplied with food, a habitation, and raiment, by an aloe *."

The American aloe must not be confounded with the common medicinal aloe, which Linnæus has placed in another genus; but which, from bearing the same name, and resembling it in external form, we shall take the liberty to mention in this place.

The genus aloe affords several species, almost all

* The tree which the abbé has thus described is not the American aloe, but the *Excæcaria agallocha* Linn. commonly called aloes-wood.

of which are natives of Africa, and most of them are to be found in the neighbourhood of the Cape. The great benefit which mankind have long derived from the juice of these plants, has occasioned their introduction into other quarters of the world; and they have been long since naturalised in India, Persia, Arabia, and the southern parts of America. The most prominent species, and those best known in the commercial world, are the *Aloe perfoliata*, and the *Aloe sinuata*. The former furnishes us with the best sort of aloes, called socotorine, from the island of Socotora, in the Indian Ocean, where the juice of the plant is prepared for the druggist, and from whence it is exported wrapped in skins. The second kind is the hepatic, or common aloes. This is obtained from the last-mentioned species, and is stronger and more nauseous than the socotorine. The *Aloe sinuata* is cultivated in Barbadoes, from whence we receive the best hepatic aloes in large gourd shells, while an inferior sort is sent to Europe in casks. The manner in which this useful plant is raised, and the juice exhausted from it, is thus described in the eighth volume of the London Medical Journal: "The lands in the vicinity of the sea, that is from two to three miles, which are rather subject to drought than otherwise, and are so stony and shallow as not to admit of the planting of sugar-canes with any prospect of success, are generally found to answer best for the aloe plant. The stones, at least the larger ones, are first picked up, and either packed in heaps upon the most shallow barren spots, or laid round the field as a dry wall. The land is then lightly ploughed, and very carefully cleared of noxious weeds, lined at one foot distance from row to row, and the young plants set, like cabbages, at about five or six inches from each other. This regular mode of lining and setting the plants is practised only by the most exact planters, in order to facilitate the weeding of them by hand, very frequently; because, if they are not kept perfectly clean and free from weeds, the produce will be but very small. They will bear being planted in any season of the year, even in the driest, as they will live on the surface of the earth for many weeks without a drop of rain. The most general time, however, of planting them, is from April to June.

"In the March following, the labourers carry a parcel of tubs and jars into the field, and each takes a slip or breadth of it, and begins by laying hold of a bunch of the blades, as much as he can conveniently grasp with one hand, while with the other he cuts it just above the surface of the earth, as quickly as possible (that the juice may not be wasted), and then places the blades in the tub, bunch by bunch, or handful by handful. When the first tub is thus packed quite full, a second is begun (each labourer having two); and by the time the second is filled, all the juice is generally drained out of the blades in the first tub. The blades are then lightly taken out, and thrown over the land by way of manure; and the juice is poured out into a jar. The tub is then filled again with blades, and so alternately, till the labourer has produced his jar full, or about four gallons and a half of juice; which is often done in six or seven hours, and he has then the remainder of the day to himself, it being his employer's interest to get each day's business as quickly done as possible. It may be observed, that although aloes are often cut in nine, ten, or twelve months after being planted, they are not in perfection till the second and third year; and that they will be productive for a length of time, say, ten or twelve years, or even for a much longer time, if good dung, or manure of any kind, is strewed over the field once in three or four years, or oftener if convenient.

"The aloe juice will keep for several weeks without injury. It is therefore not boiled till a sufficient quantity is procured to make it an object for the boiling-house. In the large way, three boilers, either of iron or of copper, are placed to one fire, though some have but two, and the small planters only one. The boilers are filled with the juice; and as it ripens or becomes more inspissated, by a constant but regular fire, it is ladled forward from boiler to boiler, and fresh juice is added to that furthest from the fire, till the juice in that nearest to the fire (by much the smallest of the three, and commonly called by the name of *tatch*, as in the manufactory of sugar) becomes of a proper consistency to be skipped or ladled out into gourds, or other small vessels, used for its final reception. The proper time to skip or ladle it out of the tatch, is when it is arrived at what is termed a resin height, or when it acts freely, or in thin flakes, from the edges of a small wooden slice, that is dipped from time to time into the tatch for that purpose. A little lime-water is used by some aloe-boilers, during the process, when the ebullition is too great.

"As to the sun-dried aloes (which is most appropriated for medicinal purposes), very little is made in Barbadoes. The process is, however, very simple, though extremely tedious. The raw juice is either put into bladders, left quite open at top, and suspended in the sun; or in broad shallow trays of wood, pewter, or tin, exposed also to the sun, every dry day, until all the fluid parts are exhaled, and a perfect resin formed, which is then packed up for use, or for exportation."

This kind of aloe is not confined to Barbadoes, but is cultivated in some of the other West India islands, where the same resin is prepared from it, though in a somewhat different manner. We learn from the same volume of the Medical Journal, that in Jamaica, after the plant has been pulled up by the roots, and carefully cleansed from the earth or other impurities, it is cut in pieces into small hand baskets or nets. These nets, or baskets, are put into large iron boilers with water, and boiled for ten minutes, when they are taken out and fresh parcels supplied till the liquor is strong and black. At this period the liquor is thrown through a strainer into a deep vat, narrow at bottom, to cool, and to deposit its fæculent parts. Next day the clear liquor is drawn off by a cock, and again committed to the large iron vessel. At first it is boiled briskly; but towards the end the evaporation is slow, and requires constant stirring to prevent burning. When it becomes of the consistence of honey, it is poured into gourds or calibashes for sale, where it gradually acquires the necessary hardness.

The caballine or horse aloes is an inferior drug, supposed to be obtained from the same plant as the hepatic, and is chiefly distinguished by its strong and rank smell.

The Mahometans respect the aloe as a plant of a superior nature. In Egypt, it may be said to bear some share in their religious ceremonies, since whoever returns from a pilgrimage to Mecca hangs it over his street-door as a proof of his having performed that holy journey. The superstitious Egyptians believe that this plant hinders evil spirits and apparitions from entering the house; and, on this account, whoever walks the streets in Cairo will find it over the doors both of Christians and Jews.

The leaves of the different species of aloe, as well as those of the agave, are highly serviceable to the natives of the countries where they grow. The negroes in Senegal make excellent ropes of them, which are not liable to rot in water; and of two kinds mentioned by sir H. Sloane, one is manufactured into fishing-lines, bow-strings, stockings, and hammocks; while the other has leaves, which, like those of the wild pine and banana, hold rain-water, and thus afford a valuable refreshment to travellers in hot climates. The poor in Mexico derive almost every necessary of life from a species of aloe. Besides making excellent hedges for their fields, its trunk serves instead of beams for the roofs of their houses, and its leaves supply the place of tiles. From these they obtain paper, thread, needles, clothing, shoes, stockings, and cordage: from the juice they make wine, honey, sugar, and vinegar.

BAMBOO.

*Designed by W. Daniell.*

*Published by Mess.rs Cadell & Davies, London March 1, 1807.*

# BAMBOO.

## HEXANDRIA MONOGYNIA.

### GENERIC CHARACTER.

Calyx none.
Corolla a bivalve glume.
Seed single.

### SPECIFIC CHARACTER.

| | |
|---|---|
| Bambusa arundinacea. | B. panicula ramosa divaricata. *Linn. Spec. Plant. Willd.* 2. p. 245. |
| | Panicle branched and divaricating. |
| | Arundo Bambos. A. calycibus multifloris, spicis ternis sessilibus. *Spec. Plent.* 120. |
| | Arundo arbor. *Bauh. Pin.* 18. |
| | Ily. *Rheed. Mal.* 1. p. 25. pl. 16. |
| | Tabaxir sive Mumbo arbor. *Bauh. Hist.* 1. p. 222. |
| Bamboo. . . . . . . | *Lamarck. Illust.* pl. 264. *Dict. d'Hist. Nat.* ed. 1803.—2. p. 530. pl. A. f. 2. |

As yet we are acquainted only with two species of bamboo, the *arundinacea*, and the *verticillata*. They are both natives of India, and from their great resemblance to reeds have been classed with them. Owing to this botanical mistake, it has been common, both in India and America, to give the name of bamboo to all those plants which resemble reeds. It is thus that travellers have been led to suppose that the genus consists of many species. Rumphius, who paid particular attention to these plants, has divided them into three classes. In the first he comprehends those with a plain and solid stem; that is to say, woody throughout. The second includes those which have the figure of a cross in the centre of their stems, and a very small cavity. His third class is formed of bamboos whose interior is so open as to form a pipe, and more in proportion than the ligneous part. These last are by far the most useful. Adanson, following Rumphius, has given in the old *Encyclopédie* the description of twenty-nine varieties of this plant, and mentioned their several uses. Of this number we shall only mention those which are of use to the Indians, either for the composition of their paper, the fabrication of their houses and domestic utensils, or as affording them a portion of their nourishment.

Of all the plants that belong to the family of grasses, the bamboo is the only one that rises to the height of a tree, with a stem of a proportionate thickness. This height varies like that of other plants, according to the soil and the situation in which it is placed. The *Bamboo Ily*, which is found in the sands of Malabar, grows to the height of sixty-six feet: it is propagated by suckers; attains the age of sixty years, and blows but once in its life.

The *Bamboo Zelin*, a kind inhabiting Java and Amboyna, arrives at the height of fifty feet. The Malays and the Macassars use the joints for water-pipes: they likewise use the wood in constructing different parts of their houses, such as the partitions, the benches, and the seats. To prepare the bamboo for this purpose, they split the middling-sized stems into either four or six laths, which they afterwards sew together. The stems, when whole, serve for the sides of ladders, for the yards of small vessels; and, as we have before said, for water-pipes: those of the largest growth are employed for joists and beams. The use of so much bamboo, however, in the construction of their houses, becomes a serious evil in case of fire; for the air contained within the hollow parts of the stems becomes rarefied, and bursts from its confinement with a violent and dangerous explosion. The natives eat the buds and suckers of this and several other varieties of bamboo; they cut about a foot of the young shoot from near the top, and, after having macerated it in water, they boil it gently, and then dividing it into slices, preserve it in vinegar. This, when served up with meat, and eaten as cabbage, is reckoned a good antiscorbutic.

The bamboo which is common over all India, and which is of so much service to the inhabitants, is the largest of all the varieties of this plant. It grows to the height of eighty feet, and measures from twelve to eighteen inches in diameter. With this they make their chests, their small boxes, and the measures for their rice. They propagate the plant by suckers of two or three joints, which they place obliquely in the ground. The vessels in the upper joints of these shoots are full of a clear water. The wood of this species, as well as that of its varieties, although extremely light, is very strong: with the thickest they make their enclosure-walls and partitions, while those of a middling size serve as levers to carry palanquins and other burthens. The Indian wine-dressers, who are employed to collect the palm-wine, make bridges of bamboo from one tree to another, so that they may pass and collect the juice without descending to the ground. The Chinese boil the young shoots to the consistence of thick milk, and of this preparation they make a kind of paper, used by their draftsmen, and sometimes to cover their parasols. The same people make several very pretty articles of furniture with what they call the *Bamboo Cho*; they likewise use it for basket-making; and for this purpose they split the stems into little straps. The *Bamboo Teba* is another kind, remarkable for the thickness of its stem, which is eighteen inches in diameter, and set with strong spines. The superior articulations, which are open, serve the inhabitants as measures for their liquors; whilst the lower joints, being plain, solid, and very durable, are used for stakes; of which the Macassars form a defensive wall, that answers the purpose of ramparts. When their king was at war with the Dutch in 1651, they fortified themselves by planting two parallel rows of these stakes at about three feet distance from each other, uniting them by hurdles of the same bamboo, and binding the whole strongly together. The interval between the two rows was filled up with the spiny branches mixed with earth and sand: thus they formed a wall which was completely cannon-proof.

The wood of the *Bamboo Tuy* (a variety common enough in the Moluccas) is so very hard, that a severe blow with an axe will make it give sparks of fire. The joints are covered with rough sheaths, like the skin of a shark or dog-fish; and they are used to polish iron, or for other purposes of a similar nature. The natives of the Moluccas and of Java manufacture the stems of this bamboo into flutes, walking-sticks, fishing-rods, tobacco-pipes, poisoned arrows, and excellent pikes, or *hassagays*, which they throw with such force as to pierce through the body of a man, after the pointed end has been gently heated in the fire to give it the requisite hardness. Among the different kinds of this useful plant may be ranked the *Arundo scriptoria* of G. Bauhin, which, amongst its other uses, furnishes the inhabitants with writing-pens. The joints of the stem are about six inches long, of a fine shining black, and almost entirely ligneous. With this they inlay their cabinets, their escritoires, and other furniture of a similar nature.

Among the many uses to which the Chinese put the bamboo, may be ranked the manufactory of paper. To accomplish this purpose we are informed, by Duhalde, that they use the open kind of bamboo, of which they reject the first bark, and only employ the second with the woody substance. They choose the shoots of the first year, and divide them into several straight bundles of six or seven feet in length. These bundles are sunk in a pond of muddy water, where they remain till their compact and tenacious parts are separated. In about fifteen days they are taken out of the pond, and after being washed in pure water they are spread in a large trench, and covered with lime. When the bamboos have been long enough in this state they are again washed, and, being separated into filaments, are exposed to the heat of the sun in order to be bleached: as soon as this is effected, the mass is put into large coppers, where it is boiled, and the operation completed by beating it with a heavy pestle till it is reduced into a fluid paste.

With this pulpy mass they mix gum water, prepared with the juice of a plant called *hoa-teng* or *ko-teng*. This melange, which resembles thick and cloudy water, they pour into large and deep reservoirs formed of four walls, breast high, the bottom and sides of which are defended by a cement, to prevent the liquor from oozing through. The workmen, who are placed on the sides of the reservoir, then dip in their moulds and raise the surface of the liquor, which almost immediately becomes paper. The frame upon which they raise the paper is not made of wire, as in Europe, but of bamboo; and when they want to make their leaves of an extraordinary size, they use a reservoir and frame in proportion.

Besides the gum-water with which the paper is impregnated, they sometimes dip every leaf in a solution of alum. This operation prevents the paper from sinking, and gives it likewise the polish which is sometimes so conspicuous on the Chinese paper. They have places on purpose for drying the leaves, where they are subject to a degree of heat that evaporates their moisture almost as soon as they are exposed to it.

In this manner they conduct the operation of paper-making; and with this account we shall now conclude the history of the bamboo, which, for the various uses to which it is applied, has hardly its equal in the whole range of the vegetable kingdom.

# LAUREL.

ENNEANDRIA MONOGYNIA.

GENERIC CHARACTER.

Calyx none.
Corolla of six oval, pointed, concave petals.
Seed-vessel an oval sharp-pointed berry, containing an oval nut.

SPECIFIC CHARACTER.

| | |
|---|---|
| LAURUS NOBILIS. | L. foliis lanceolatis venosis perennantibus, floribus quadrifidis dioeciis. *Linn. Spec. Plant. Willd.* 2. 479. |
| | Leaves lanceolate, veined, and perennial. Flowers quadrifid, dioecious. |
| | L. foliis ovato-lanceolatis, ramis floriferis folio brevioribus. *Hall. Helv.* no. 1602. |
| | LAURUS VULGARIS. *Bauh. Pin.* 460. |
| COMMON LAUREL. | *Blackw. Herb.* pl. 157. femina. *Mill. Dict. Tourn. Ins.* 597. |

NONE of the species of this interesting genus has been so much celebrated, or so highly honoured, as the common laurel. Amongst the antients it was placed in the most distinguished situations; it graced the brows of their conquerors, and adorned their splendid triumphs: it was at all times the reward of military virtues and great talents. Besides a crown of laurel which was decreed to the successful general at the conclusion of a campaign, he bore in his hand a branch of the plant as a symbol of his victories, and entered Rome surrounded by trophies of a similar nature. The tents, the vessels, the fasces, and even the lances of the soldiery, were ornamented with the same. This laurel was also consecrated to Apollo, in consequence of his attachment to the plant after the transformation of Daphne. The antient physicians supposed it possessed of extraordinary virtues, and considered it as an universal panacea. It was probably for this reason that they adorned the statue of Esculapius with its leaves. From the custom which prevailed in some places of crowning the young doctors in physic with the laurel in berry, (*baccæ lauri,*) these students were called *Bachelors.*

This shrub is too common to require a particular description of its form. It is sufficient to say that its bark is thin and green ; its wood strong and pliable; its flowers whitish-yellow, growing in little umbels, and supported on footstalks shooting from the axils of the leaves. These flowers are dioecious, that is to say, the males grow on one plant, while the females occupy another. The fruit is an oval berry of a blueish black colour when ripe.

Entire forests of this species of laurel are found in Africa. In the temperate and even the cold parts of Europe it is cultivated as an ornament to our gardens, where it flowers in March and April, and ripens its berries in autumn. All parts of this tree are aromatic. The leaves bruised between the fingers exhale an agreeable smell, and give to the taste an acrid bitter flavour. They likewise serve to season our aliments, and are well known to the lovers of a bowl of punch, who considerably improve their liquor by the addition of a few laurel leaves. When they are distilled, (after being macerated a few hours in water,) they give out an essential and powerful oil. The berries, which are employed in medicine, have a strong but agreeable smell, and a sharp, bitter, and aromatic taste.

Several of the species which compose this genus are of considerable service to mankind, particularly the cinnamon and camphor; of which we shall proceed to give such an account as the limits of our work will permit. The cinnamon-tree (*Laurus Cinnamomum* Linn.) is a native of India, and grows in great abundance in the Island of Ceylon. Of this tree Sir Charles Thunberg has given a history in his Travels, to which Mr. Percival has made considerable additions in his Account of the Island of Ceylon. From this interesting work, therefore, we shall chiefly collect our particulars respecting the cinnamon.

Mr. Percival informs us, that the principal cinnamon woods, or gardens, as they are called in Ceylon, lie in the neighbourhood of Columbo. They reach to within half a mile of the fort, and fill the whole surrounding prospect. The grand garden near the town is said to occupy a tract of country from ten to fifteen miles in length. "Nothing," says

Mr. Percival, "can be more delightful to the eye than the prospect which stretches around Columbo. The low cinnamon trees which cover the plain, allow the view to reach the groves of evergreens, interspersed with tall clumps, and bounded every where with extensive ranges of cocoa-nut and other large trees. The whole is diversified with small lakes and green marshes, skirted all around with rice and pasture fields. In one part the intertwining cinnamon trees appear completely to clothe the face of the plain; in another, the openings made by the intersecting foot-paths just serve to show that the thick underwood has been penetrated.

"The soil best adapted for the growth of the cinnamon is a loose white sand. Such is the soil of the cinnamon gardens around Columbo, as well as in many parts around Nigumbo and Caltura, where this spice is found of the same superior quality. What is gathered at Matura and Point de Galle differs very little from this, especially in those parts near the sea, which are most favourable to the growth of cinnamon. The quantity found in the other parts of the island is so trifling, as hardly to deserve notice. Of late years, little is procured from the interior; and what is brought thence is coarser and thicker in appearance, and of a hot and pungent taste. The interior is not so well adapted by nature for producing this plant; and the exactions and avarice of the Dutch at length reduced the king of Candy to such desperation, that he resolved to secure himself against their future attacks, by leaving nothing in his dominions that could excite their covetousness. With this view he has, since the last treaty he was forced to make with them, employed every means to prevent the growth and propagation of the cinnamon tree."

The Island of Ceylon affords several kinds of cinnamon trees, which are known by different names: some of these from their appearance may readily be mistaken for the true cinnamon, and four of them indeed are allowed by government to be barked for commercial purposes. We shall not, however, take any further notice of these varieties, but confine ourselves to the description of the species which really constitutes the wealth of Ceylon. This is a tree of a small size, from four to ten feet in height: the trunk is slender, and has several branches and twigs shooting out from it on every side. The wood is soft, light, and porous, in appearance much resembling that of our osier; and, when barked, it makes good fire-wood, for which purpose it is commonly used. A vast number of roots and fibres run from the root of the tree, and, shooting up into slender twigs, form a bush around it. The leaf resembles the laurel, and is at first scarlet, but afterwards changes to a green. It is deserving of remark, that the leaves taste and smell strongly of cloves, and that an essential oil has been distilled from them, with all the properties of that spice, while that obtained from the wood is decidedly of the flavour of cinnamon.

We learn from Mr. Percival that the blossom of the cinnamon tree is white, and when in full bloom seems to cover the woods. "It is probable," says this gentleman, "from the great distance to which an object of this colour is seen, that voyagers have been led to affirm that the cinnamon may be smelt far at sea off the island. This assertion is in fact a mere fiction, as even in passing through the woods I never could perceive any scent from the tree, except by pulling off some of the leaves or branches. The flower has even less scent than the leaves or a bit of twig.

"The cinnamon tree produces a species of fruit resembling an acorn, but not so large, which gets ripe about the latter end of autumn, and is gathered by the natives for the purpose of extracting oil from it. The process they employ is to bruise the fruit, boil it, and skim off the oil: this they use for their hair and body on great occasions, and also for burning in their lamps. When mixed with cocoa-nut oil it gives an extremely good light. The kings of Candy use it for this purpose, and formerly commanded their subjects to bring them a certain quantity as a yearly tribute. When any ambassadors are sent to these princes, they always burn this oil during the time of audience. When the tree gets old and decayed, and most of the branches fit for barking have been stripped off, it is customary to set fire to it, and burn it down to the ground; the roots are seen to shoot up again in strong straight plants, much better formed than the preceding ones. From these are cut the highly esteemed cinnamon walking-sticks, which, when fresh, are of a lively green, resembling holly; but after some time the bark becomes shrivelled, and they have very much the appearance of hazel sticks. They still, however, retain the taste and smell of cinnamon. The bark of these shoots is extremely valuable, and the practice of cutting them when young for sticks has been found to prove so materially injurious, that it has been totally prohibited since the island came into our possession.

Before the Dutch were in possession of Ceylon, the cinnamon grew entirely in a wild state, and it was then supposed that cultivation would prove injurious to the plant, by causing it to degenerate: this, however, was not found to be the case, and the cultivated cinnamon is now acknowledged to be in every respect equal to the wild. The plantations not only yield a spice of equal quality with the wild, but are infinitely more commodious for the people employed in barking, from the trees being regularly placed in rows, instead of being scattered through intricate and pathless woods.

The manner of barking and preparing the cinnamon for exportation is thus described by Mr. Percival: "There are two different seasons in which cinnamon is barked. The greater quantity is prepared during what is called the *grand harvest*, which lasts from April to August. The *little harvest* continues for little more than a month, from November to January. The barking is, however, by no means restricted to these particular seasons;

I have observed bark brought in every month of the year.

" Each particular district where the cinnamon grows is bound to furnish yearly a certain quantity of cinnamon, proportioned to the number of villages and inhabitants which it contains. The Cinglese, in return for this service, have each a piece of land allotted them rent free. They are also exempted from other government services, and enjoy other privileges in proportion to the quantity which they deliver. Those who are employed to bark the trees are called *schjalias* by the Dutch, and by us *choliahs*. Over them are placed officers of a superior class, whose business it is to superintend the workmen, to take charge of the woods, and to prevent cattle and improper persons from trespassing there. Besides these, there is a set of officers of a higher cast, called *cinnamon moodeliers*, whose business it is to judge and punish all small offences, and to superintend the different districts and villages where the choliahs reside. Over the whole a head officer is placed, usually known by the Portuguese name of Captain *Cannaillé*, which means Captain *Cinnamon*. He is styled by the natives *Corundu Mohabadda*, or Chief of Cinnamon. The chief moodelier receives all the reports concerning the woods, and the cinnamon affairs in general, from the inferior officers, and transmits them to the captain, who is accountable only to the governor.

" The process of preparing the cinnamon for exportation is as follows: It is the first care of the choliahs to find out a tree of the best quality. This their sagacity and practice easily enable them to do, from the leaves and other marks. Such branches as are three years old, and appear proper for the purpose, are then lopped off with a large crooked pruning-knife. From these branches the outside thin coat of the bark is scraped off with a knife of a peculiar shape, concave on the one side and convex on the other. With the point of this knife the bark is ripped up longwise, and the convex side is then employed in gradually loosening it from the branch till it can be taken off entire. In this state the bark appears in the form of tubes open at one side; the smaller of which are inserted into the larger, and thus spread out to dry. The heat of the sun, by quickly drying up the moisture, makes the tubes contract still closer, till they at last retain the form in which we see them in Europe. When sufficiently dry, the bark is made into bundles of about thirty pounds weight each, and bound up with pieces of split bamboo twigs. These bundles are carried by the choliahs to the cinnamon *go-downs* or storehouses belonging to the company. As they are brought in, each bundle is marked and weighed, and placed in the heap of the particular district or village to which those who brought it belong; each heap being kept separate till the quantity expected from the district be made np. The several processes required in cutting and barking the cinnamon are parcelled out among several classes of choliahs, who are employed only to perform their own particular branches; by this subdivision of labour the service becomes much easier to them, and much more profitable to their employers.

"The next step, after the cinnamon has been carried into the company's storehouses, is to examine its quality. This task is imposed upon the company's surgeons, and a very disagreeable one it proves to be. It is performed by taking a few sticks out of each bundle, and chewing them successively, as the taste is the only sure method of ascertaining the quality. The cinnamon, by the repetition of this operation, excoriates the tongue and the inside of the mouth, and causes such an intolerable pain as renders it impossible for them to continue the process above two or three days successively. The surgeons are however obliged in their turns to resume it, as they are responsible for the goodness of the cinnamon: it is customary for them to mitigate the pain by eating a piece of bread and butter between whiles. The best cinnamon is rather pliable, and ought not much to exceed stout writing-paper in thickness. It is of a light yellowish colour; it possesses a sweet taste, not so hot as to occasion pain, and not succeeded by any after-taste. The inferior kind is distinguished by being thicker, of a darker and brownish colour, hot and pungent when chewed, and succeeded by a disagreeable bitter after-taste.

"After the quality of the cinnamon has been by this means ascertained, it is made up into large bundles, each about four feet long, and all of the same weight. The weight of each bundle is, at the time of packing up, eighty-five pounds, although it is marked and reckoned for only eighty pounds; five pounds being allowed for the loss by drying during the voyage. The bundles are firmly bound and packed up in coarse cloths made of strong hemp from the cocoa-tree; and are then carried on board the ships which touch at Ceylon for that purpose."

The refuse of the cinnamon is distilled for the sake of its water and essential oil, which last, from the little that is yielded by the wood, is extremely dear. Mr. Percival saw a pint bottle of it set up for sale among the effects of the late Dutch governor; but as it was put up at ten pounds sterling, no one chose to bid for it. An oil is obtained from the leaves of this tree, which, as we have already observed, smells exactly like oil of cloves. The oil extracted from the best cinnamon is of a bright gold colour, while that obtained from wood of an inferior quality is darker and brownish.

The camphor tree, *Laurus camphora* Linn., is of a moderate size, of an elegant shape, and of delicate foliage. It has a straight trunk, divided towards the top into many little branches. The leaves are alternate; of an oval-lanceolate shape, smooth on both sides, and marked with three longitudinal nerves, which unite a little above the base. These leaves, when rubbed between the fingers, diffuse a very strong smell of camphor. The small whitish flowers are supported on short peduncles, forming clusters of fifteen or eighteen on each stalk. They are succeeded by a blackish fruit, about the size of a pea, which has a fleshy pulp, that both smells and tastes of camphor; within this is a stone containing an insipid kernel.

The camphor is an evergreen tree, growing in Japan and other parts of the East Indies. The wood is white, rather hard, and marked with reddish waves. It is employed in India for several purposes, on account of its fragrant smell. From this tree we obtain that valuable drug which is so well known for its medicinal virtues; and which may be considered as one of the immediate principles of vegetation, since it is not confined to one species of plant, but exists in a greater or less degree in most vegetables. This singular substance is dispersed over all parts of the tree; and to obtain it, the country people, in some provinces, cut the wood into little bits, which they put over the fire in a vessel constructed for the purpose, having a large head to it filled with stubble. When the wood is sufficiently heated the camphor sublimes like white soot, and settles in the head, from whence it is easily removed by shaking the stubble. In this state it is friable, grained, and of a yellowish brown colour, like moist sugar, and full of impurities.

In China they call the camphor tree *tchang*, and the camphor *tchang-nao*. To extract the camphor, they take the green branches of this tree and cut them into little bits, which they steep for three days in well-water. After the cuttings have been thus macerated, they are put into a kettle and boiled, during which process they incessantly stir the liquor with a willow stick. When the juice from the wood adheres in a quantity to the stick, in the form of a white jelly, it is time to strain it: having done this, and separated all the dirt and impurities, they pour the juice into a glazed earthen pan, where it is left all night, and the next day they find it coagulated and formed into a mass.

In this state the camphor is of a bad colour, and requires to be purified before it is fit for sale. To accomplish this purpose they provide a spacious copper bason, at the bottom of which they put some hard powdered substance, such as the rubbish of an old wall ground very fine; upon this they put a layer of camphor, covering it with some of the same substance, then another layer of camphor, and so on till the fourth layer of this gum resin has been covered with the powdered substance. The process being conducted thus far, they lay on the top of all a quantity of the leaves of the plant *po-ho*, or pennyroyal, and close the whole with a copper cap which is luted to the bason with yellow ochre. A fire is then lighted under the vessel, and care taken to manage it so that the heat shall be as regular as possible; this heat is continued a given time, after which the fire is suffered to go out and the vessel to cool: upon separating the copper head the camphor will be found adhering to its inner surface. To get this substance very pure, it may be necessary to repeat the sublimation two or three times.

# CASHEW-NUT.

### ENNEANDRIA MONOGYNIA.

GENERIC CHARACTER.

Calyx of five oval sharp-pointed divisions.
Corolla of five linear-lanceolate petals, about twice the length of the calyx.
Seed a kidney-shaped nut, situated at the apex of a large fleshy body of a pyriform figure.

SPECIFIC CHARACTER.

| | |
|---|---|
| Anacardium occidentale. | Anacardium. *Linn. Spec. Plant. Willd.* 2. p. 486. |
| | Pomifera, sive potiùs Prunifera indica, nuce reniformi. *Catesb. Carol.* 3. p. 9. pl. 9. |
| | Acajou. *Pis. Bras.* 38. |
| | Cassuvium. *Rumph. Amb.* 1. p. 177. pl. 69. |
| | Cuschon. *Mer. Sirin.* 16. pl. 16. |
| | Kapa-mava. *Rheed. Mal.* 3. p. 65. pl. 54. |
| Cashew-Nut. . . . . . | *Jacq. Amer.* 124. pl. 181. f. 35. *Blackw.* pl. 369. |

This is the only species of the genus as yet known to botanists, at least the only one acknowledged in the Linnæan arrangement; for Lamarck refers us to two, of which one is distinguished by broad leaves, the other by long. The last Lamarck believes to be the same with the *Semecarpus anacardium* Linn. It is known by the name of Malacca-bean, or marsh-nut, and, in consequence of yielding a considerable quantity of varnish, is much sought after by the Chinese, and by the inhabitants of the neighbouring countries.

The cashew-nut grows naturally in the hotter parts of Asia and America, where it arrives at the height of more than twenty feet. The leaves are nearly twelve inches long, and the fruit is as large as a moderate-sized pear, and somewhat of the shape. This fruit is full of an acid juice, and is singular in having a kidney-form nut attached to its lower end, which appears as if it had been fixed to it rather by art than nature. This appendage has a very hard shell enclosing a kernel of a very pleasant taste, not unlike the pistachia. Between the kernel and the shell is contained a thick, blackish, inflammable liquor, of so caustic a nature that the skin blisters almost immediately upon its being applied to any part of the body, particularly the lips. This caustic liquor is esteemed an admirable cosmetic by the West India young ladies, though rather rough in its operation. Nothing indeed but that great desire which prevails with the sex to preserve a beautiful face, could ever make them endure the torture of this oil with common fortitude: they literally flay themselves alive; and the manner in which they proceed to commit this barbarity is described as follows:

When any of the young ladies fancy themselves too much tanned by the scorching rays of the sun, they gently scrape off the thin outside of the shell to get at the oil, with which they rub their faces all over. The effect of this application is immediate; the parts which have been rubbed swell and grow black, and the skin being poisoned by the caustic oil, in the space of five or six days comes entirely off in large flakes, so that they cannot appear in public in less than a fortnight; by which time the new skin looks as fair as that of a young child.

The negroes in Brazil are said to cure themselves effectually of disorders in the stomach by eating the fruit of this tree, which, being of an acid nature, is supposed to promote digestion, and remove obstructions. It appears, however, that this cure is not voluntary, since the Portuguese deny them any other sustenance, and suffer them to seek the cashew-nuts in the woods, allowing them their choice, either to eat the fruit or starve.

The young shoots, called *bibo*, are eaten in India, and the milky juice of the tree forms a good black ink for marking linen, which will not wash out.

# VENUS FLY-TRAP.

## DECANDRIA MONOGYNIA.

### GENERIC CHARACTER.

Calyx of five leaves.
Corolla of five oblong petals.
Seed-vessel a single cell, containing many small seeds.

### SPECIFIC CHARACTER.

Dionæa muscipula. Dionæa. *Ellis in Nov. Act. Upsal.* 1. p. 98. pl. 8. *Hoult. Linn. Pfl. Syst.* 6. p. 497. pl. 50. *B.*

Venus Fly-trap. . *Shaw Nat. Miscel. Darwin Bot. Gard.* 2. p. 19. pl. 3.

This is one of the wonders of the vegetable creation. It is an american plant, growing in Carolina, and producing several elegant white flowers at the end of a simple stalk. But the curious part of the fly-trap, and that from whence it derives its name, is the leaves; these are all of them radical, *i. e.* growing immediately from the bottom of the stem, and each is terminated by two lobes surrounded with prickles. In the particular organization of this part of the plant we find something very singular, The lobes, when undisturbed, lie open like the leaves of a book, and from their surfaces, which are covered with a number of minute glands, is secreted a sweet liquor that attracts the unwary fly. The moment an insect alights upon the leaf it closes, or folds up, so as to prevent the escape of the fly, and either crush or pierce it to death. The irritability in the surface of the leaves, together with the attracting syrup with which they are provided, and the rows of prickles, which, like the teeth of a rat-trap, surround their edges, are evidently contrived by nature to effect a purpose which appears inconsistent with the office of a vegetable. The ant-eater, which lays its long and glutinous tongue on the ground, and silently waits till it is covered with insects, is employed in search of food which is essential to its existence: but the plant, with organs as manifestly contrived for the purpose, has no apparent end to answer in the capture, since the animal juices of a fly can hardly be supposed to contribute any thing towards the nourishment of a vegetable.

The leaves may at any time be excited; for, if a light substance be drawn along the middle rib, they will almost immediately fold up, so as to cross and interlock the prickles that grow on the edge of each lobe.

In this plant the singularity of structure is in the leaves. In a species of dogs-bane, the *Apocynum androsæmifolium*, it is in the flowers. The end to be effected is the same in both, and they are equally the objects of curiosity. A little honey-bag or nectarium, seated at the bottom of the flower-cup, and guarded by five converging anthers, invites the fly to enter and enjoy the sweets; but when the little animal inserts his proboscis between the anthers to arrive at the honey, they close with violence and detain him prisoner. Dr. Darwin was shown a fly thus held fast by the end of its proboscis, which, he tells us, in vain struggled to disengage itself, till the converging anthers were separated with a pin. The gentleman to whom the doctor was indebted for the sight of this curiosity, had the plant growing in his garden, and on some days observed that almost every flower had entrapped a fly. He thus mentions the plant in some observations which he afterwards sent to Dr. Darwin:

"My apocynum is not yet out of flower. I have often visited it, and have frequently found four or five flies, some alive, and some dead, in its flowers; they are generally caught by the trunk or proboscis, sometimes by the trunk and a leg: I don't know that this plant sleeps, as the flowers remain open in the night; yet the flies frequently make their escape. In a plant of Mr. Ordoyno's, an ingenious gardener at Newark, who is possessed of a great collection of plants, I saw many flowers of an apocynum with three dead flies in each: they are a thin-bodied fly, and rather less than the common house fly; but I have seen two or three other sorts of flies thus arrested by the plant."

# CAMRUNGA.

DECANDRIA PENTAGYNIA.

GENERIC CHARACTER.

Calyx of five small leaves.
Corolla of five lanceolate petals.
Seed-vessel a pentangular fleshy fruit, divided into five chambers containing many seeds.

SPECIFIC CHARACTER.

| | |
|---|---|
| Averrhoa carambola. | A. foliis ovatis inæqualibus acuminatis, fructibus oblongis acutangulis. *Linn. Spec. Plant. Willd.* 2. 751. |
| | Leaves oval, unequal and sharp-pointed; fruit oblong and acute-angular. |
| | A. foliis impari-pinnatis, foliolis ovato-acutis, terminale majore, fructuum angulis ovatis. *Cavan. Diss.* 7. p. 374. pl. 220. |
| | Prunum stellatum. *Rumph. Amb.* 1. p. 115. pl. 35. |
| | Tamara Tonga sive Carambolus. *Rheed. Mal.* 3. p. 51. pl. 43, 44. |
| Camrunga. . . . . | *Bruce, Philos. Trans.* 1785. p. 356. |

This plant, like the mimosa, possesses the singular faculty of moving when touched; and is one of those instances of irritability in the vegetable kingdom, of which we daily witness the effect without being able to explain the cause. It is a native of India, and is known in Bengal by the name of *camrue* or *camrunga*. We are principally indebted for the following account to a paper in the fifty-seventh volume of the Philosophical Transactions, where the writer tells us that the leaves are alternately pinnated, with an odd one at the end; that in their most common position in the day-time they are horizontal; and that in the mimosa the moving faculty extends to the branches; but from the hardness of the wood this is not the case with the camrunga. The leaves, on being touched, move themselves downwards, frequently in so great a degree that the two opposite almost touch one another by their under sides, and the young ones sometimes either come into contact, or even pass each other. The whole of the leaves of one pinna move by striking the branch with the nail of the finger or other hard substance; or each leaf can be moved singly by making an impression that shall not extend beyond that leaf. In this way the leaves on one side of the pinna may be made to move, one after another, whilst the opposite continue as they were; or they may be made to move alternately, or in short in any direction we please, by touching, in a proper manner, the leaf we wish to put in motion. If the impression, although confined to a single leaf, be strong, all the little leaves on that side, and sometimes the neighbouring ones, will be affected by it. It is singular, that notwithstanding this apparent sensibility of the leaf, large incisions may be made in it with a pair of sharp scissars, without occasioning the smallest motion; nay, it may even be cut almost entirely off, and the remaining part still continue unmoved, when, by touching the wounded leaf with the finger or point of the scissars, motion will take place as if no injury had been offered. This is accounted for by supposing the leaf-stalk to be the only seat of sense and action: and this indeed seems to be the case; for although the leaf may be cut in the way we have just mentioned, and even squeezed with considerable force; yet, if the impression made does not affect the leaf-stalk, no motion will take place.

Whether the impression be made by puncture, percussion, or compression, the motion does not instantly follow: generally several seconds intervene, and then it is not by a jerk, but regular and gradual. Afterwards, when the leaves return to their former situation, which is commonly in a quarter of an hour or less, it is in so slow a manner as to be almost imperceptible.

On sticking a pin into the base of the leaf-stalk, where it issues from the branch, the leaflet next it, which is always on the outer side, moves first; then the first leaflet on the opposite side, next the second on the outside, and so on. But this regular progression seldom continues throughout; for the outer leaflets seem to be affected both more quickly, and with more energy, than the inner ones; and sometimes a leaflet, especially on the inner side, does not move at all, whilst those above and below it are affected in their proper time. On making a compression with a pair of pincers on the common leaf-stalk, between any two pair of leaves, those above the compressed part, or nearer the extremity of the stalk, move sooner than those under it, or nearer the origin; and frequently the motion will extend upwards to the end leaflet, whilst below perhaps it does not go further than the first pair. If the leaves happen to be blown by the wind against one another, or against the branches, they are frequently put in motion; but when a branch is moved gently, either by the hand or the wind, without striking against any thing, no motion of the leaves takes place.

When left to themselves in the day-time, shaded from the sun, wind, rain, or any disturbing cause, the appearance of the leaves is different from that of other pinnated plants. In the last a great uniformity subsists in the respective position of the leaflets; but here some will be seen on the horizontal plane, some raised about it, and others fallen under it; and in the space of an hour or two, all these will have changed their respective positions, without having observed any order or regularity in their movement.

After sun-set the leaves go to sleep, first moving down so as to touch one another by their under sides; they therefore perform rather more extensive motion at night of themselves than they can be made to do in the day-time by external impressions. With a convex lens the rays of the sun may be collected on a leaf, so as to burn a hole in it, without occasioning any motion: but upon trying the experiment on the leaf-stalk, the motion is as quick as if from strong percussion, although the rays be not so much concentrated as to cause pain when applied in the same degree on the back of the hand. The electric shock, even when very gentle, has a powerful effect on the leaves, causing them to move with great celerity.

The flowers in this species of averrhoa are axillary, that is, growing from the angle formed by the union of the leaf-stalk with the stem. The fruit is an oval fleshy berry, with five angles, and divided within into five chambers, each containing one or more seeds. It is about the size of a hen's egg, has a crude but not disagreeable flavour, and is said to promote the appetite. On account of these properties it is given in the East (mixed with sugar) for the cure of bilious fevers and dysentery.

MANGROVE.

*Designed by W. Daniell.*

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# MANGROVE.

## DODECANDRIA MONOGYNIA.

### GENERIC CHARACTER.

Calyx divided into four oblong, sharp-pointed leaves.
Corolla of four petals.
Seed-vessel fleshy, and containing a single seed.

### SPECIFIC CHARACTER.

RHIZOPHORA GYMNORHIZA. R. foliis ovato-lanceolatis integerrimis, radice terræ superimposita. *Linn. Spec. Plant. Willd.* 2. p. 843.

Leaves ovate-lanceolate and entire; root upon the surface of the earth.

R. calycum laciniis persistentibus patentibus versus fructum incurvatis. *Wachend ult.* 89.

MANGIUM CELSUM. *Rumph. Amb.* 3. p. 102. pl. 68.

MANGROVE. . . . . . *Rheed. Mal.* 6. pl. 31, 32.

THIS singular tree is a native of the East Indies, where it grows to the height of ten or twelve feet, and is always found in moist and marshy places, generally within the influence of the sea, and where the tide can readily wash its stem. The mangrove is divided into a vast number of branches which extend on all sides, and are thickly covered with oval shining leaves, about five or six inches long. The trunk and the lower branches send out several round flexible shoots, which descend to the ground, and there take root. These shoots, in time, become so interlaced as to produce an almost impenetrable grove, somewhat resembling the banyan tree, but much thicker.

There is something exceedingly curious in the manner which Nature has chosen to conduct the seed of the mangrove to the earth. It is a remarkable deviation from the general rule, and is simply thus: the fruit produces a single seed enclosed in an oval capsule, which, when ripe, begins to germinate without falling from the tree. A little radicle makes its appearance from the top of the capsule, from whence it proceeds in the form of a ligneous fibre till it is more than a foot long. In this state the seed hangs pendent, till by its weight, added to the continual oscillations to which it is subject from the slightest breath of air, it is disengaged from the capsule, and falls to the ground. The process which follows is common to other seeds. Several fibres shoot from one end of the seed; the two cotyledons are forced open; the plumule, or young plant, bursts from between them, supported in its growth by their nourishing juice, till the fibres are converted into roots sufficiently strong to carry on the subsequent process of vegetation. The seeds are said to fall so as to rest on the earth in a vertical position: this may easily happen where the ground is perpetually moist, and soft enough to receive any impression, which is the case where these trees are found.

The bark, which the Chinese employ to strike a black dye, exhales a very strong smell of sulphur; and the wood, which partakes of the same odour, burns very briskly, and with a bright dazzling flame.

In consequence of the mangrove trees growing, as it were, in the water, they become the retreat of fishes, and especially of oysters. These last deposit their spat upon the stems and branches, which in time become loaded with them; and the oysters gathered from such situations, may be readily known by pieces of the wood which are generally attached to the shells.

# TEA TREE.

POLYANDRIA MONOGYNIA.

GENERIC CHARACTER.

Calyx small, divided into five or six parts; leaflets round and obtuse.
Corolla of six roundish concave petals.
Seed-vessel consisting of three globes united together, each containing a single seed.

SPECIFIC CHARACTER.

| | |
|---|---|
| Thea Bohea. | Floribus hexapetalis. *Linn. Spec. Plant. Willd.* 2. p. 1180. no. 1. Flowers with six petals. |
| | Thee. *Kampfer. Jap.* 605. t. 606. |
| | Thee Frutex. *Barr. Rar.* 128. pl. 904. |
| | Thee Sinensium. *Bregn. Cent.* 111. t. 112. f. 17. t. 3. |
| | Bohea Tea. *Lettsom. Sect.* 8. p. 39. pl. 2. |
| | Thea viridis. T. floribus enneapetalis. *Linn. Spec. Plant.* 2. p. 1180. no. 2. Flowers with nine petals. |
| | Thea Cantoniensis. *Lour. Cochin.* 414. |
| | Thea Sinensis. *Black.* pl. 351. ℞. |
| Tea. . . . | *Lettsom, Nat. Hist. of the Tea Tree.* |

In the *Nouveau Dictionnaire d'Histoire Naturelle*, the writer, M. du Tour, has begun the above article to this effect. Tea is a Chinese and Japan shrub, celebrated for its leaf, immense quantities being annually exported into other countries, with which the North Americans and Europeans, particularly the English, compose an agreeable drink. The leaf bears in commerce the same name as the plant. The tea leaf, as well as that of tobacco, affords us a striking example of the power of habit over mankind. Before the conquest of the New World, and the discovery of a passage to the East Indies by the way of the Cape of Good Hope, the Europeans neither used tea nor tobacco; at present not a day passes without their using both. Within these two centuries, fleets have been equipped, and men and money sacrificed, to ransack both Indies in search of vegetable productions, of which neither the possession nor the use is calculated to increase the happiness of the people, or diminish their wants. The taste of Europeans for Indian productions is worthy of observation. We are not astonished that the inhabitants of Pekin should indulge themselves with tea all the day long; the plant grows in their country, and was presented them by nature; but that a people situated five or six thousand leagues from China or Japan, should venture so much to procure this favourite drink, and, not content with their excellent beer, and the pipes of wine which their commerce procures them, should make a great part of their enjoyment consist in taking about twenty cups of tea in the course of twenty-four hours, appears singularly ridiculous. Among the various kinds of beverage which the English consume, this holds the first rank. This nation alone consumes more than all the rest of Europe: they attach so much importance to its use, that the first mark of politeness they show to strangers is an invitation to drink tea with them.

So much for M. du Tour, to whose accusation we in part plead guilty.—We are fond of tea, go many thousand miles to fetch it, and invite strangers to partake of our beverage, but seldom or ever drink *twenty* cups in the course of twenty-four hours. The plant, it must be confessed, is become of great importance to this country, whether considered in a commercial light, or as affording us an agreeable infusion, which custom has rendered necessary to our comfort: it therefore behoves us to pay particular attention to its history; and, accordingly, we have collected all the information on the subject that we could procure, independent of such as is not immediately connected with its natural history. It will, however, be but just, before we begin, to acknowledge the assistance we have received from the works of Kæmpfer and Thunberg; from Le Compte's, Du Halde's, and Grosier's China; from Lord Macartney's Embassy, and from Dr. Lettsom's Natural History of the Tea Tree.

*Description of the Tea Tree.*

This shrub grows but slowly, and does not arrive at its full size till it is six or seven years old. It attains the height of four or five feet, and sometimes rather more: the root is black, woody and branched; the stem is divided into several irregular branches, covered with a thin bark, and tinged with green towards the extremity of the young shoots. The wood is hard, fibrous, and but sparingly provided with pith. The leaves are attached to the branches by a short, slender pedicle, and when of their full size resemble the leaves of the black cherry tree both in figure and colour; but when young, and before they are fit to be gathered, they are not unlike the leaves of the common euonymus, except in colour. They are numerous, of an intense green, serrated at the edges, and disposed alternately on the branches. The flowers spring from the axils of the leaves; they are sometimes solitary, and sometimes united, two or three together. When full-blown they measure an inch or more, have an agreeable smell, a white colour, and resemble in form the common wild rose. The calyx is cut into five or six segments, and the corolla consists of eight or nine petals; the stamens are very numerous,—Kæmpfer counted two hundred and thirty, each having a slender filament shorter than the corolla, crowned with a simple yellow anther. The style is unique, and placed in the centre of the stamens, and the germ, to which it is connected, becomes, when ripe, a tough capsule, sometimes simple, but more frequently composed of two or three partitions, each containing a roundish stone that encloses a kernel, from whence the Chinese in the province of Fokien express an oil which they use for some particular purposes.

*Cultivation of Tea.*

With respect to the cultivation of tea in Japan, we learn, from Kæmpfer, that no particular gardens or fields are allotted for this plant, but that it is raised about the hedges and borders of their fields, without any regard to the quality of the soil. The seeds are sown, together with their capsules, in holes dug at equal distances from each other, and about four or five inches deep; into each of these they put a number of seeds, usually not less than six or more than twelve. It is necessary to put several into the earth at a time, because they are apt to turn rancid, and perhaps not more than one in five of them will succeed.

As soon as the young shoots appear above the surface of the earth, it is common with some to mix manure with the mould, and carefully weed the plants, while others suffer them to grow up without paying any particular attention to them. In about seven years after the seed has been sown, the plants will have arrived at the height of a man: but as at that time they grow slowly, and produce but few leaves, it is customary to cut them down; which occasions such an exuberance of fresh shoots and leaves the succeeding summer, as abundantly repays the owners for their former loss and trouble. Some cultivators delay this cutting till the tenth year.

The cultivation of this shrub in China is similar to that in Japan, except that, instead of suffering it to grow promiscuously, they plant whole fields with it. It likewise appears from the abbé Grosier's account that they differ in another respect, since the Chinese of the province of Kiang-nan are the only people who crop the tea shrub; for every where else it is suffered to grow to its natural size, which sometimes, says Grosier, extends to ten or twelve feet. When the tree is very young, they take care also to incline and bend down its branches, that they may collect its leaves afterwards with greater ease. This shrub seems particularly to delight in sheltered valleys, the declivities of hills, or the banks of rivers where it enjoys a southern exposure to the sun. These warm situations are not, however, absolutely necessary to the welfare of the plant, since it grows in the northern clime of Pekin, as well as about Canton. It is also to be found on the rugged tops of steep mountains, whose sides are sometimes inaccessible. When this is the case, the Chinese, in order to come at the leaves, make use of a singular stratagem. These steep places are generally frequented by great numbers of monkeys, which, being irritated and provoked, revenge themselves by tearing off the branches, and showering them down upon their enemies, who immediately collect the fragments and strip them of their leaves.

*Gathering of the Leaves.*

We are indebted to Kæmpfer for the best account of this process, who tells us that, at the proper season for gathering the leaves, those who plant many shrubs hire a number of labourers, whose business it is to attend to this employment. They are careful not to pluck the leaves by handfuls, but detach them from the branches one by one; and tedious as this method may appear, one man will gather ten or twelve pounds a day. This quantity, however, will depend on the abundance of the crop and the quality of the tea; neither do they gather them all at once, but generally make three harvests at three different times.

The first gathering takes place at the end of February or the beginning of March, when the plant has put forth but few of its leaves, which are only two or three days old. At this time they are viscid, small, and tender: the tea which is made from them is reckoned by far the best, and from its scarcity is reserved for princes and rich people; for this reason it is called Imperial tea.

The second gathering is made about the end of March, or in the first days of April. The leaves at this season are much larger, without having lost any of their flavour: they, however, differ with respect to their maturity, some being arrived at perfection, while others have not attained their full growth. Nevertheless they are gathered promiscuously, but sorted afterwards into different classes, according to their age, size, and quality; the youngest particularly are carefully separated, and are often sold for the first gathering, or Imperial tea.

The third gathering, which is the last and most abundant, commences a month after the second, which happens about June, when the leaves have acquired their full size and thickness. In some places they neglect the two preceding crops, and attend alone to this. This kind of tea, called *Bantsjaa*, is the coarsest, and chiefly consumed by the lower class of people.

### *Preparation of the Tea-leaves.*

In China and Japan they have different ways of preparing the leaves; the method described by Kæmpfer is as follows: Public buildings or drying-houses having been erected in the isles of Japan for the purpose of curing the fresh-gathered tea, every private person who has no suitable conveniences, or who is unacquainted with the operation, may carry his leaves thither to be dried. These buildings contain a great number of small stoves, raised about three feet high, each having at the top a large iron plate, either high, square, or round, bent up a little on that side which is over the mouth of the furnace, that the operator may be secured from the heat, and the leaves at the same time be prevented from falling off. The workmen are seated round a large table covered with mats, where they busily employ themselves in rolling the leaves. The iron pan being heated to a proper degree by a little fire placed in a furnace beneath, a few pounds of fresh-gathered leaves are put in, which, being green and full of sap, crackle as soon as they touch the pan. They are then stirred by the workman, with his naked hands, as quickly as possible, till they become so warm that he cannot easily endure the heat. When the process has proceeded thus far, he takes off the leaves with a kind of shovel resembling a fan, and pours them upon the mats to the rollers, who, taking a small quantity at a time, roll them in the palms of their hands in one direction, while others are continually employed in stirring them in order to cool them the sooner, and make them preserve their shrivelled figure a longer time.

That their moisture may be thoroughly evaporated, and their curl more completely preserved, this process is repeated twice or thrice, and sometimes oftener, before the tea is deposited in the warehouses; with this difference, that on every repetition the pan is less heated, and the operation performed in a more slow and cautious manner.

The people in the country are not so particular in preparing of their tea: they are contented with drying the leaves in earthen vessels over the fire, which being a much simpler process is of course less expensive; and on this account they are enabled to sell their tea at a much lower price.

The common tea is preserved in earthen pots with narrow mouths; but the best sort of tea, used by the emperor and nobility, is put in porcelain or china vessels. The *Bantsjaa*, or coarsest tea, is kept by the country people in straw baskets, made in the shape of barrels, which they place under the roofs of their houses, near the hole that lets out the smoke, and imagine that this situation does not injure the tea.

The popular opinion, that the green colour of the fine sort of tea is occasioned by the use of copper plates, is entirely without foundation. Father Le Compte, indeed, has mentioned the circumstance; but we have no reason to place implicit credit on what he says, particularly as the observations of subsequent authors have invariably contradicted his assertion. Sir George Staunton, after giving a few particulars respecting the growth of the tea-plant in China, says, that the young leaves undergo no inconsiderable preparation before they are delivered to the purchaser. "Every leaf passes through the fingers of a female, who rolls it up almost to the form it had assumed before it became expanded in the progress of its growth. It is afterwards placed upon thin plates of earthenware or iron, made much thinner than can be executed by artists out of China. It is confidently said in the country, that no plates of copper are ever employed for that purpose. Indeed, scarcely any utensil in China is of that metal, the chief use of which is for coinage. The colour and astringency of green tea are thought to be derived from the early period at which the leaves are plucked, and which, like unripe fruit, are generally green and acrid."

Sir George informs us that the tea is packed in large chests, lined with very thin plates of lead and the dried leaves of some large vegetable. "It is but too true, that the tea is pressed down into those chests by the naked feet of Chinese labourers, as grapes are pressed by the wooden shoes of European peasants; in which last case the juices are purified by the subsequent fermentation. Notwithstanding this uncleanly operation of Chinese packers, the upper ranks in China are as fond of tea as the people are, and particularly solicitous in their choice of it."

*The different Kinds of Tea mentioned by the Chinese.*

Several kinds of tea are distinguished by the Chinese, all of which may be reduced to four principal varieties; viz. the *Song-lo tcha*, the *Vou-y tcha*, the *Lou-ngan tcha*, and the *Pow-eul tcha*.

The name of the first is derived from the mountain *Song-lo*, situated in the province of *Riang-nan*. This mountain, which is described as far from extensive, is entirely covered with the tea shrub, as well as the bottoms of several others in the neighbourhood. This is the kind which we call green tea. It is cultivated almost like the vine, and cropped when it arrives at a certain height, to prevent it from shooting beyond its strength. The *Song-lo tcha*, when carefully kept, will preserve its flavour for several years, and is used by the inhabitants of the country as an excellent remedy in various disorders.

The *Vou-y tcha*, however, is the kind of tea in most esteem throughout the Chinese empire. The best of this forms the Imperial tea, and is the same as that gathered in Japan for the sole use of the imperial family. The care which is taken to preserve this precious shrub, and to gather its leaves without injury, is thus noticed by Grosier: "The finest and most celebrated tea of Japan is that which grows near *Ud-si*, a small village situated close to the sea, and not far distant from *Meaco*. In the district of this village is a delightful mountain, having the same name, the climate of which is said to be extremely favourable to the culture of tea; it is therefore enclosed by a hedge, and surrounded with wide ditches, which prevent all access to it. The tea shrubs that grow on this mountain are planted in regular order, and are divided by different avenues and alleys. The care of this place is intrusted to people who are ordered to guard the leaves from dust, and to defend them from the inclemency of the weather. The labourers who are appointed to collect the tea, abstain from every kind of gross food for some weeks before they begin, that their breath and perspiration may not in the least injure the leaves. They gather them with the most scrupulous nicety, and never touch them but with very fine gloves. When this choice tea has undergone the process necessary for its preparation, it is escorted by the superintendant of the mountain and a strong guard, to the emperor's court, and reserved for the use of the imperial family.

The *Vou-y tcha* tea, which is known in Europe by the name of Bohea, is considered as lighter, sweeter, and of a more delicate taste than the *Song-lo*. The second sort of it, which is composed of older leaves, is sold in common with other teas; and the third, which consists of leaves that have been suffered to remain on the tree till they have attained their full size, is of a much inferior quality, and sold to the common people at a cheap rate.

The *Lou-ngan tcha* derives its name from a city near which it grows. This seems to be the same as the *Song-lo,* somewhat altered in its properties by soil and situation.

The village of *Pow-eul,* in the province of *Yunnan,* from whence the fourth kind of tea is procured, is become of importance in consequence of its commercial dealings in this single article. We are told that people resort to it from all parts; but that the entrance is forbidden to strangers, who are not permitted to approach nearer than the bottoms of the mountains, to receive the quantity of tea which they want. The leaves of this shrub are longer and thicker than those of the *Song-lo tcha,* and *Vou-y tcha*; they are formed into masses, rolled up like tobacco, and sold at a dear rate. This tea, which is much used in some of the Chinese provinces, is of a less agreeable flavour than the other kinds.

The Mogul Tartars use a kind of tea which is composed of the refuse of all the rest. This is known by the name of *Kaiel tcha,* and serves these people as a beverage to assist them in digesting their raw flesh.

### *The Uses and Properties of Tea.*

The Chinese drink their tea in the same manner as we do, but without either sugar or milk. The emperor *Kien-long* has composed a little poem in praise of this infusion, to the following effect: "Put on a moderate fire a three-legged vessel, the form and colour of which bespeak long services; fill it with limpid water procured from melted snow; boil it to that degree which is necessary to whiten fish, or redden crabs, and immediately pour it over the tender leaves of choice tea put into a cup made of the earth *yué*. Leave it at rest until the vapours, which at first rise in abundance, form thick clouds, afterwards gradually disappear, at length vanish, and leave only some light exhalations floating on the surface; then, at leisure, sip this delicious liquor. It will effectually dispel those five causes of inquietude that generally assail us and disturb our repose. We may taste, we may feel, but we cannot express, the soft tranquillity occasioned by a liquor prepared in this manner."

The Japanese nobility drink the very essence of the finest tea, which they extract in the following manner: The tea is reduced to a fine powder, by grinding the leaves in a hand-mill; and when the tea equipage is introduced, a quantity of this powder enclosed in a box is set before the company. The cups are then filled with boiling water, and as much of the powder as will lay on the point of a knife is taken out of the box, thrown into each of the cups, and stirred with an instrument like a tooth-pick till the liquor begins to foam; in which state it is presented to the company, and sipped warm.

The poorer class of people, who drink an inferior tea, prepare their infusion in a different manner. They make use of this liquor for their common beverage, and we seldom see a picture, in which any labourers are represented, without the tea equipage as an accompaniment. The first thing in the morning, even before sun-rise, the Japanese peasant places his kettle of water over the fire, and puts into it two, three, or four handfuls of the *Bantsjaa* tea leaves, according to the number of his family. It should be noticed that a small basket is previously sunk in the kettle, that the leaves may be readily drawn out again when their virtue is extracted. Where this basket is wanting, it is common with them to enclose the tea in a bag. The kettle is generally large enough to serve the family for the day, and they apply to it whenever they feel inclined, drawing up the liquor with a little cup which they keep for the purpose.

The art of making tea in a graceful manner is considered of so much consequence in Japan, that the young people of both sexes are taught by professors, who make it their business to instruct them, in the same manner as an European would be taught any branch of polite education.

The poor people, particularly in the province of Nara, sometimes boil their rice, which is their common food, in an infusion of tea, which, they believe, increases its nutritive quality.

According to Bomare, the nobility in China use an extract of tea, and likewise pastils of tea, aromatized, which are of an agreeable flavour. When this preparation is used, a piece about the size of a small bean is put into the boiling water. They also dry the buds of the tea shrub, and drink the tea made from them as a delicacy.

When the tea has been kept till it has lost its flavour, and is no longer fit to drink, it is used by the Asiatics to dye their silken stuffs, to which it imparts a chestnut brown colour. It is for this purpose that a vast quantity of the leaves is annually sent from China to Surat.

Neither the Chinese, nor the people of Japan, ever use their tea before it is a twelvemonth old, as it is very apt to prove narcotic, and disorder the senses when fresh. Kæmpfer says that an infusion made from the green leaves will produce apparent drunkenness, and great nervous disorder; these violent effects, however, are considerably removed by drying. Nevertheless it ought not to be used the same year it is gathered.

There can be little doubt that the fine effluvia from our finest tea is pernicious to particular constitutions. Dr. Lettsom distilled an ounce of highly odorous water from half a pound of green tea, which produced great nervous irritability, while that which remained in the retort was quite innocent. This gentleman has likewise mentioned some cases where we may fairly suspect this effluvia to have caused the mischief; of these the two following will be sufficient for our purpose.

"An eminent tea-broker, after having examined in one day upwards of one hundred chests of tea, only by smelling at them forcibly, in order to distinguish their respective qualities, was the next day seized with a violent giddiness, head-ache, universal spasms, and loss of speech and memory. By proper assistance the symptoms abated, but he did not recover. For though his speech returned, and his memory in some degree, yet he continued, with unequal steps, gradually losing strength, till a paralysis ensued, then a more general one, and at length he died. Whether this was owing to the effluvia of the tea may perhaps be doubted. Future accidents may possibly confirm the *suspicions* to be just, or otherwise.

" An assistant to a tea-broker had frequently for some weeks complained of pain and giddiness of his head, after examining and mixing different kinds of tea. The giddiness was sometimes so considerable, as to render it necessary for a person to attend him, in order to prevent any injury he might suffer from falling or other accident. He was bled in the arm freely, but without permanent relief; his complaint returned as soon as he was exposed to his usual employment. At length he was advised to be electrified, and the shocks were directed to his head. The next day his pain was diminished, but the day after closed the tragical scene. I saw him a few hours before he died; he was insensible; the use of his limbs almost lost, and he sunk very suddenly into a fatal apoplexy. Whether the effluvia of the tea, or electricity, was the cause of this event, is doubtful. In either view the case is worthy of attention *."

*The Introduction of Tea into Europe.*

The first European writer who has alluded to the tea plant is Giovani Botero: this person published a treatise in 1590, in which he does not immediately mention its name, but describes it in a manner which sufficiently explains what he meant. "The Chinese," says he, "have an herb out of which they press a delicate juice, which serves them for drink instead of wine; it also preserves their health, and frees them from all those evils which the immoderate use of wine produces among us."

About the year 1600, the dried leaves were seen, in Malacca, by one Texeira a Spaniard, who was told that the Chinese prepared an infusion from them. In 1633 the practice was noticed among the Persians; and in 1639 the Russian ambassador, at the court of the Mogul, partook of the infusion, and was offered a quantity of the leaves at his departure as a present for the emperor, which he refused as a useless article.

* From these instances of the deleterious effects of tea, one might be led to suppose that the same unhappy consequences would frequently attend those who are employed in examining and mixing different kinds of tea in China: but there the teas are mixed under an open shed, through which the air has a free current, by which the odour and the dust are dissipated; but in London this business is usually done in a back room, confined on every side.

Tea was first introduced into Europe about the year 1610, by the Dutch East India company, and in 1666 a quantity of it was brought from Holland to this country by lord Arlington and lord Ossory. Soon after this period tea became a fashionable beverage among the people of quality, and the use of it by degrees descended to all ranks. We must conclude, however, that tea was used in England before the period above mentioned, since it appears from an act passed in 1666, that a duty on tea, among other articles, was then settled on the king during his life. At this time a pound of tea sold for sixty shillings, and continued at this price till the year 1707. Since the year 1720 the demand for this article has been rapidly increasing. In the beginning of the last century the annual quantity imported by the East India company did not much exceed 50,000 pounds weight; in the year 1797, nearly twenty millions of pounds were sold at their public sales! This is an increase of four hundred fold in less than a century, and since the year 1797 a still greater quantity has been annually imported.

From the great demand which has long prevailed for this favourite article, the Chinese have found it necessary, or at least profitable, to adulterate it, and bad tea is now become an universal complaint: but unfortunately the mischief does not stop there; for it appears from Mr. Twining's pamphlet, that many tricks are played with it in this country, some millions of pounds of ash, sloe, and other leaves of trees, having been sold as tea, notwithstanding three acts of parliament which have been made to prevent such practices. Mr. Twining gained the following information respecting this subject from a gentleman who had inquired particularly into the business.

The *smouch* for mixing with black teas is made of the leaves of the ash. When gathered they are first dried in the sun, then baked; they are next put upon a floor, and trod upon until the leaves are small, then sifted and steeped in copperas with sheep's dung; after which, being dried on a floor, they are fit for use. They have, likewise, another method which does not differ materially from this.

The quantity manufactured at a small village, and in its neighbourhood, cannot be exactly ascertained, but it is supposed to be about twenty tons in a year. One man acknowledges to have made 600 lbs. weight in every week for six months together! The fine is sold at 4l. 4s. the hundred weight, equal to nine pence a pound. The coarse at 2l. 2s. equal to 4½d. a pound. Elder buds are likewise said to be manufactured in some places to represent fine teas.

# BAOBAB TREE.

MONADELPHIA POLYANDRIA.

GENERIC CHARACTER.

Calyx of one leaf, cup-shaped, and half five-cleft.
Corolla of five roundish petals.
Seed-vessel oval, divided into ten cells, containing many kidney-shaped seeds.

SPECIFIC CHARACTER.

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|---|---|
| ADANSONIA DIGITATA. | *Linn. Spec. Plant. Willd.* 3. p. 730. |
| | Abavo arbor; radice tuberosa. *Bauh. Pin.* 434. |
| | Abavo tree with tuberose root. |
| | GUANABANUS SCALIGERI. *Bauh. Hist.* 1. p. 109. *Raj. Hist.* 1371. |
| BAOBAB TREE. . . . | *Alp. Ægypt.* 66. pl. 67. *Bauh. Hist.* 1. p. 110. *Dict d'Hist. Nat.* ed. 1803. 2. p. 544. pl. A. 23. *Mem. de l'Acad. des Sciences,* 1763. *(Adanson.)* |

THE tree which goes by the name of baobab is one of the largest productions of the vegetable kingdom. It is of African origin, and flourishes in Senegal; but what is highly remarkable in this species is, that notwithstanding its immense size, a trifling injury is sufficient to destroy it. We are told that it thrives best in moist and sandy situations, though it is occasionally found in stony districts. If this tree be wounded deeply in the principal root, (even the least scratch is pernicious,) it soon begins to rot, and the evil spreading to the trunk quickly destroys the tree. Besides the rot, which attacks the trunk when the root is cut, the baobab is subject to another evil, not so common indeed, but equally fatal. This is a kind of mouldiness which spreads over all the woody part, and so softens it, that the tree no longer preserves its usual consistence. In this state the trunk, monstrous as it is, can no longer resist the violence of the winds, but falls a sacrifice to the first storm that blows.

In its native country the seed of the baobab, sown in a sandy earth where there is plenty of moisture, will vegetate in the course of seven or eight days; and in a month the young tree will be a foot high. In the first summer its altitude will be increased to five or six feet, and its stem to an inch or an inch and a half in diameter. In this manner the plant continues progressively to increase, till, from a slender stick, it becomes in time a most prodigious tree. Some of those which Adanson saw in Senegal measured twenty-seven feet in diameter, and Ray says that between the rivers Niger and Gambia their dimensions are so monstrous, that seventeen men, joining hands, could hardly surround one of them: from which we may conclude that the largest of these trees were about eighty-five feet in circumference, and thirty in diameter. Golberry likewise, in his Travels in Africa, tells us that he met with them of thirty-four feet in diameter. Although the baobab is very tender, and susceptible of injury, it must survive a vast number of years, or it could never arrive at the amazing size we have just stated; and as a proof of its longevity we shall quote Golberry, who measured one of the trees mentioned by Adanson, thirty-six years after that celebrated naturalist, and found that it had only increased a foot and some inches in circumference, or about eight lines in diameter!

The baobab contains within its substance a great quantity of mucilage, or gummy matter, which is slightly acid. The leaves, boiled in water, give out this mucilage so as to make the decoction viscous. The fruit, which is a thick, oval, and hairy capsule, contains a number of seeds enclosed within ten separate chambers, and the white spongy flesh which surrounds these seeds is of an acid and agreeable flavour. This, however, is only while it is eaten fresh, as it loses much of its goodness by keeping.

This tree is reckoned the most useful and salutary of any that grows in Senegal. The negroes make great use of its leaves, which they dry in a shady place, and afterwards grind to a green powder called *calo*. This powder is kept in cotton cloths and used daily, two or three pinches being put into their *couscous* or other dish. This is not done by way of improving the flavour of this meat, for the leaves have none, but to moderate the excessive perspiration to which they are subject in that hot country, by lowering the circulation of the blood. They also make a diet drink of the leaves to preserve them from those fevers which are common to the country; and this is either sweetened with sugar or liquorice, to make it more palatable. The fruit too is very much esteemed, and is scarcely less useful than the leaves, since the fleshy part of it serves them for nourishment, either eaten alone, or in milk. It is likewise an object of some importance when considered in a commercial light; for the *Mandingues* carry it to the eastern and central parts of Africa, whilst the Moors and Arabs trade with it in Morocco; in this manner it has been spread over Egypt, and all the eastern side of the Mediterranean. It was in these last countries that they reduced the pulp into powder, and exported it from the Levant under the very improper name of *Terra sigillata* of Lemnos.

The ligneous bark of the husk, and the fruit itself when it is spoiled, serve the negroes for soap: all the preparation required is to boil it with a ley mixed with palm oil that is turning rancid, or with an oil extracted from a kind of kermes, which is very common in certain districts.

But the natives have another use for this tree, which is very singular. They make large cavities in the trunks of those that are rotten, forming them into chambers, or rather vast caverns, where they hang the dead bodies of such persons as have forfeited the rites of sepulture; these bodies in time become perfectly dry, and are complete mummies without any other preparation. The greatest number of persons so suspended, are said to have been jugglers, or to have pretended to a superior knowledge, by which they drew upon themselves the indignation of the other negroes, who considered them as sorcerers.

# COTTON PLANT.

MONADELPHIA POLYANDRIA.

GENERIC CHARACTER.

Calyx double.
Corolla of five inversely heart-shaped petals.
Seed-vessel roundish, divided into three or four chambers, containing several oval seeds.

SPECIFIC CHARACTER.

| | |
|---|---|
| Gossypium herbaceum. | G. foliis quinquelobis mucronatis subtus uniglandulosis, caule herbaceo læve. *Linn. Spec. Plant. Willd.* 3. p. 803. |
| | Leaves divided into five pointed lobes with a single gland beneath; stem smooth and herbaceous. |
| | G. foliis quinquelobis subtus uniglandulosis, lobis rotundatis mucronatis, calyce exteriore serrato. *Lamarck. Encyclop.* 2. p. 133. |
| | G. frutescens, semine albo. *Bauh. Pin.* 430. |
| Cotton Plant. . . . | *Cavan. Diss.* 6. p. 310. pl. 164. f. 2. *Blackw. Herb.* pl. 354. |

This useful plant is found in Cyprus, in the island of Candia, in Syria, and in the Indies; it is also cultivated in Malta, and in Sicily. In Europe this species of cotton is annual, but in some parts of Africa it is said to be perennial, and to form a moderate sized shrub. The usual height of the plant, in those countries where it is raised for commercial purposes, is about two feet; the stem is hard, woody, and hairy on the upper part. The leaves, which are divided into five lobes, are remarkable for a green gland situated on the back. The peduncles issue from the axils of the leaves, and each bears a yellow flower, with a toothed calyx.

Among the numerous productions of the vegetable kingdom there is not one, perhaps, that can exceed the cotton in point of general utility. A vast number of trees, shrubs, and herbs, are calculated to afford us nourishment; but there are very few that furnish us with the materials for clothing. Among these few the cotton plant ought to be placed in the first rank. Hemp and flax, which are cultivated in the temperate and colder parts of Europe, are certainly of great service to mankind, and afford a maintenance to a number of people employed in the manufactory of their produce; but while these herbs require several long and laborious preparations to form their gummy bark into thread, the cotton offers to the inhabitants of both Indies a substance ready formed by Nature to their hands. The fineness of the thread, and the transcendant whiteness of this soft down, induced mankind to cultivate the plant, and the value of its produce soon rendered them solicitous to propagate and multiply it as much as possible. Thus the different species (for there are several,) became objects of commerce in the four quarters of the globe; for although Asia and America afford the principal quantity, yet it is cultivated both in Europe and Africa.

It would perhaps be very difficult to distinguish all the varieties of the cotton plant which are cultivated for commercial purposes in the different parts of the world, nor would it be at all to our purpose to attend to this subject; for us it is sufficient to know that the shrub thrives best in hot countries, where it sometimes grows several feet in height; and that before America was discovered by the Europeans, many species of cotton grew wild which have since been turned to account, with the addition of several from Asia and Africa, which have been transported there at different times, and found to succeed admirably well.

The history of a plant of so much importance as the cotton, ought not to be slightly passed over; we shall therefore give some account of its cultivation in the different quarters of the world, after having described that part of the plant which produces this valuable article.

The corolla (or flower) consists of five petals, containing many stamens united at the base into a column, and bearing on their tops as many kidney-shaped anthers. From a roundish germen proceeds a style as long or longer than the stamens, and crowned with three or four thick stigmas. The capsule is the size of a small egg, of a spherical or rather oval figure, divided into three or four valves, and having as many chambers full of green or black seeds surrounded by a white, yellowish, or reddish down. This down is the cotton, and is of different degrees of length and fineness. When the down is ripe it bursts the valves, and spreads itself over the sides of the capsule.

### *Cultivation of Cotton in Europe.*

The *Gossypium herbaceum* is cultivated in the island of Malta, in Sicily, in a part of Calabria, and in some of the isles in the Archipelago. It has likewise been attempted to raise the plant in France; and from the success which the agriculturists met in their first essays, there can be no doubt of the possibility of effecting it in Provence, in Dauphiné, and in Languedoc.

This species of cotton succeeds, as we have just remarked, in Sicily, in the island of Malta, and in Calabria. The manner in which it is cultivated in these three countries is much the same. The territory of *Terra Nuova*, which stretches along the shore to the west of Syracuse, in the valley of Noto, is the part of Sicily more particularly destined to the cultivation of cotton. The land which they employ for this purpose is of a good quality, and free from noisome weeds: they till the ground five or six times from November to April, and water it in May. When it is sufficiently moistened they sow the seeds of the cotton plant, after having previously soaked them in water, and rubbed them well to detach the filaments. When this operation is completed, the husbandmen rake the earth, not with a harrow, that being an uncommon instrument in Sicily, but with the branches of trees bound together and drawn over the land by oxen. This practice promotes the germinating of the grain, by confining the necessary moisture within the earth. As the seed degenerates every year, and at length ceases to produce cotton of a good quality, the Sicilian cultivators are obliged to come to Malta; and the Maltese, for the same reason, exchange their seed for that produced in Sicily.

In Malta the cultivation of cotton has been for a long while one of the most considerable branches of agriculture in the country. All parts of the island are not equally proper for this purpose, though there is land sufficient for the cultivation of three distinct kinds, the *herbaceous cotton*, the *cotton of Siam*, and the *cotton which comes from the Antilles*, and which is a taller plant than either of the preceding.

The Maltese ladies amuse themselves in picking the cotton, and the Maltese are very expert in making the thread which is employed in the manufactory of different kinds of hosiery. Of late years they have made great improvements in their cotton thread, which appears to be partly owing to the Indian workmen that have been sent to their assistance from the coast of Malabar.

In Calabria, the districts in the neighbourhood of the town of Lecce, in Otranto, and Gallipoli, are more particularly appropriated to the cultivation of the cotton plant. They plough the ground in January, and again in April: in May they sow the seed, and gather the fruit in September or October. They export the greatest part of their produce, either in the form of thread, or in other states. In Lecce they manufacture common muslins, and in several other towns they work the cotton into stockings and counterpanes.

In Syra, one of the islands in the Archipelago, the inhabitants are careful to prepare the cotton-seed before they sow it, and for this purpose they proceed in the following manner: having procured a quantity of river-sand, they mix it with the seed, pouring water repeatedly over the mass, and stirring it well together: it is then rubbed with their hands on a flat stone, until all the down which may have adhered to the seed is separated, after which it is cleaned from the sand, and fit to be sown. The species which they cultivate in this island is not so handsome as some; nevertheless it produces a reddish cotton of a good quality, which becomes perfectly white after repeated washings.

Some years ago the cotton plant was raised with success in Spain; so much so, that in the province of Valencia a sufficient quantity of land was occupied by it, to produce in the year 1783 four hundred weight of cotton.

*Cultivation of Cotton in Asia.*

Although Asia produces a greater number of cotton plants than any other part of the world, yet we have not any exact description of the manner in which they are raised or propagated. Voyagers have for the most part neglected to say any thing on the subject. China, the East Indies, the Mogul empire, the kingdom of Siam, of Pegu, and the country of Bengal, produce at this moment immense quantities of cotton, of which the most part is exported in a crude state, or converted into different stuffs, that have long been the admiration of Europeans for the beauty of their texture.

Marsden informs us that in the island of Sumatra they cultivate two kinds of cotton, both of which yield this substance of an excellent quality, and in great abundance.

In Persia it is very common. Gmelin describes it as growing in rich lands, and says that in those districts of Masandaran where the soil is poor, they are obliged to supply the deficiency with manure. The plants are arranged in furrows, at about a foot distance from each other, and a moderate quantity of rain is highly necessary to make them succeed. The cotton harvest in this part of Asia begins about the end of September.

This little shrub is equally common in Arabia, but we are totally ignorant in what manner it is cultivated. In Syria and in Palestine its use appears to be confined to domestic purposes. In Asia

Minor and in Natolia it has, for a length of time, been cultivated by the Turks, the Armenians, and the Greeks. Smyrna and Aleppo carry on a considerable traffic in this article, and the plains of the former are said to produce it in great abundance.

It is common in the island of Cyprus, where a very beautiful cotton is grown that sells in Europe at an advanced price: nevertheless, even here there are different degrees of fineness in this article, and each harvest has its cotton of different qualities. The inhabitants divide the cotton into two kinds; that which grows near running streams, and that which is raised in dry places. The first is cultivated about the villages, where there are little brooks or rivulets, from whence they water the plants. The cotton thus produced is infinitely superior in quality to that which is raised in dry places, without any moisture to refresh the shrubs except what falls from heaven. In April the inhabitants begin to sow the cotton-seed; they consider this as the best time of the year: but as at this season a species of locust annually visits the island and commits great ravages, just as the young plants are beginning to shoot, they purposely retard the culture, that their crop may not be injured by them. A good harvest in this island will produce five thousand bales of cotton; when only three thousand are raised, the harvest of that year is considered as but indifferent. Whilst the island was in the possession of the Venetians, they have even produced as much as thirty thousand bales:

but the population of this spot having decreased considerably since that period, the culture of this plant has diminished in proportion, and is now reduced to the annual quantity which we have just stated.

### *Cultivation of Cotton in Africa.*

The little comparative knowledge we have of this vast quarter of the world prevents our saying much about its products. Nevertheless it appears certain that this shrub is cultivated, not only on the coasts, but likewise up the country; since the caravans which annually travel from the interior of Africa to Egypt, for the commerce of slaves and gum, carry with them cotton stuffs, of which the colour and form are sufficient to stamp them of African origin. In Senegal, at Sierra-Leone, and in the European factories on the coast of Guinea, samples of cotton are frequently seen, which have been brought from the interior by the negroes, and bartered for other commodities. Although this cotton is beautifully soft and white, it is less esteemed by the negroes than that of a bright yellow colour, which is found in the kingdom of Dahomy, where the exportation of this precious article is prohibited by very severe laws.

These plants are never raised at the Cape of Good Hope; at least they are not mentioned by travellers who have visited that part of Africa; which we presume would have been the case had the cotton been cultivated in that quarter. We are under the same incertitude with respect to the Caffre country and Ethiopia, although the climate of both these places is very well calculated to promote its growth.

It is said that considerable quantities of cotton were once cultivated in Egypt. This, however, has been doubted by some, who suppose that it was not the production of their own country, but imported from Persia and India by the way of the Red Sea. What is now grown by the Egyptians appears to be more for domestic purposes than for any commercial speculation. The climate of Barbary is well calculated to produce good cotton; but the plant is unknown there, the inhabitants being content with their fine wools, which they not only make into garments, but export to considerable advantage.

### *Cultivation of Cotton in America.*

After having reviewed the cultivation of this useful vegetable in the three other quarters of the world, we now come to the last, which in this, as well as in other respects, is by no means the least considerable. In the West Indies, in Guinea, and in the greatest part of Brazil, the culture of this plant is particularly attended to; and such is the genial nature of the soil, that it grows almost in any situation. The plants generally flourish for four or five years successively, after which they rapidly decline in strength, and produce but little cotton. Their place is then supplied by others, and the manner in which the plants are raised is as follows:

In a shady situation, as much as possible defended from the north and north-east winds, the planters prepare the land, and dig trenches into which they put the seeds. A very small quantity of rain is sufficient to make them shoot, and in about three weeks or a month the plants are sufficiently grown to require thinning. In doing this they pull up all the superfluous ones, leaving but very few in each trench. At a certain period of the growth of these shrubs, they contrive to stop, or rather to check the circulation of the sap in the main stem, so as to throw it into the lateral branches. This practice, when properly managed, forces the plants to subdivide, by which means they become more fruitful.

If the season proves favourable, the cotton harvest begins about seven or eight months after the seed is sown, and it is generally three months before all the crop is gathered. In some countries they have two harvests, but the first is always the most abundant. Sometimes, from the negligence of the negroes the crop is very much injured. They gather the capsules by handfuls, mixing the cotton with the dry leaves, and the dirt which adheres to them: thus the mill through which the capsules are passed becomes clogged, and the cotton damaged. When a negro collects the cotton in a proper manner, he draws the branches of the plant gently towards him, and is careful not to bruise them, as he is well aware that if the branches are injured the capsules which are not quite ripe will never come to perfection. The baskets used for the purpose of collecting the cotton, hold about fifty pounds weight, which, when full, they carry to the master's house, and spread the contents to dry in the sun, on cloths. After the cotton has been thus exposed for two or three days, it is picked, and then carried to the magazine. This repository is supported on strong piles of wood, lined with tin; which prevents the rats, which are extremely fond of cotton seeds, from doing any mischief.

The cotton is separated from the seeds by being passed between rollers of wood, placed in a horizontal direction, one above another, and turned by means of a handle. Some of these cotton-mills are constructed upon a very large scale, and turned by water. The French have one in the island of St. Lucia which turns a roller forty feet long, and twenty in diameter. But this is not all; for the same cylinder during its rotation turns eight or ten smaller mills to which it it is connected.

The cotton is packed for exportation in bags or sacks, which for this purpose are suspended on stakes. After a certain quantity of cotton is put in, a negro treads it down, and that it may lie the closer it is not unusual to wet the sack. The compression which it undergoes from the feet of the negroes is highly necessary, as the closer it is packed, the less the commodity suffers from those unavoidable accidents which it is liable to during the time of its exportation.

When the harvest is over, they take the opportunity of wet weather to cut the plants down; which occasions them to shoot again the next season with double vigour, and greatly improves the ensuing crop.

# MOVING PLANT.

### DIADELPHIA DECANDRIA.

#### GENERIC CHARACTER.

Calyx a single leaf, half five-cleft.
Corolla papilionaceous and striated.
Seed-vessel a compressed, bivalve, articulated pod, containing kidney-shaped seeds.

#### SPECIFIC CHARACTER.

| | |
|---|---|
| Hedysarum gyrans. | H. foliis ternatis ovali-lanceolatis obtusis, lateralibus minutissimis, panicula terminali, lomentis inferne repandis scabriusculis pendulis. *Linn. Spec. Plant. Willd.* 3. pt. 2. p. 1185. no. 38. |
| | Leaves three together, obtuse, and of an ovate-lanceolate shape: the two lateral leaves very small; flower-spike terminal; lomentum hanging down, bent back, and rough. |
| Moving Plant. . . | *Jacq. Icon. Rar.* 3. pl. 565. *Darwin, Bot. Gard. Act.* ed. 2. p. 221. pl. 7. |

This singular plant is a native of Bengal, where it is known amongst the natives by the name of *chundali borrum.* The stem is round, smooth, and branched; the leaves, which grow three together on the same leaf-stalk, consist of one of considerable size, which is long, and tapering to a point, besides two very small ones which are situated at the base of the other. The flowers are of the papilionaceous kind, and grow in clusters at the end of the stalk, producing a legume or pod that contains several seeds.

The moving plant exhibits one of those phænomena which is calculated to arrest our attention, as much perhaps from the great singularity of the appearance, as from any particular desire to discover the cause. The lateral leaves are in continual motion, without any regard to time, order, or direction. One leaf will frequently be agitated, while its opposite companion remains perfectly quiet; some will move but little, while others are almost turned round. In the day-time the middle leaf is extended in a horizontal direction, but at night it declines and lies close to the branches. This is generally immoveable, while the lateral leaves are constantly in action. In India all the leaves are in motion at the same time, as it is there in full vigour, and has every advantage which its native soil and air can give it; but in colder climates, where it is confined to the green-house, its movements are by no means so prompt, nor does the plant ever retain that action and vigorous motion which it enjoys in Bengal. It has been remarked that the general motion of the lateral leaves is alternate; that it is the little petiole or footstalk, to which they are attached, that communicates the motion; that the leaves describe the arc of a circle, and that they move downwards with less facility than they do in a contrary direction.

The cause by which this singular faculty in the *Hedysarum gyrans* is effected, still remains to be discovered. It seems necessary to the very existence of the plant; and as a proof of its importance in the œconomy of this vegetable, the leaves are always in the greatest state of agitation when the plant is in full bloom, and the germ begins to swell. From this circumstance we may infer that there is something more in this motion than we are aware of; and that the opinion of Broussonet, that the agitation of the air is the principal cause of this phænomenon, will hardly be admitted; especially as the plant continues to move day and night, whether exposed to the open air, or shut up from its influence in the green-house.

The power which actuates this plant, from whatever stimulus it may proceed, is not easily destroyed; since the leaves will continue to move for some days after a branch is separated from the main stem, provided it is kept in water.

The Indians, who observe these motions with a kind of superstitious reverence, and who are ever ready to place a confidence in the subject of their admiration, gather on a certain day two of the lateral leaves of this plant, while they are in the act of approaching each other. These they pound, together with the tongue of a species of screech-owl, and firmly believe that this preparation will prevent their being crossed in love, by rendering the object of their affection propitious.

# INDIGO.

DIADELPHIA DECANDRIA.

GENERIC CHARACTER.

Calyx of one leaf, with five teeth.
Corolla papilionaceous.
Seed-vessel a long pod, filled with kidney-shaped seeds.

SPECIFIC CHARACTER.

Indigofera Anil. I. foliis pinnatis oblongis trijugis, racemis folio brevioribus, leguminibus falcatis, caule fruticoso. *Linn. Spec. Plant. Willd.* 6. p. 1236.

Leaves pinnated, oblong, three pair of leaflets together; flower-stalk shorter than the leaves; pod hooked; stem shrubby.

Indigofera foliis pinnatis; foliolis ellipticis acutiusculis, leguminibus declinatis recurvis, caule erecto. *Mant.* 2. p. 272.

Indigo. . . . *Nouv. Dict. d' Hist. Nat.* 12. p. 14. pl. E 18. fig. 1.

This and the *Indigofera tinctoria*, to which it is very nearly allied both in appearance and properties, are the two species of this genus which are principally cultivated for their colouring matter.

There are several other kinds which produce a feculum of a similar nature with those we have just mentioned; but none, we believe, are so universally cultivated, or produce an equal quantity of this valuable dye.

The *Indigofera anil* is the species which is generally cultivated in the Antilles and in the other parts of America. It grows naturally in the East Indies, and is in figure a little, straight, delicate shrub, furnished with slender branches, which, spreading, form a tuft. It grows to the height of two or three feet, sometimes more, especially when it is planted in a congenial soil. The main stem is sometimes divided near the bottom into several lesser ones, and their colour is grayish intermixed with green. From the branches grow a number of leaves situated alternately, and composed of three and sometimes four pair of pinnæ, besides an odd leaflet at the end. Like the rest of the leguminous plants, it produces a papilionaceous flower, and a podded seed-vessel enclosing several seeds.

The foliage of this kind of indigo exhales a sweet, penetrating, but rather flattish smell. The flower-stalks spring from the axils of the leaves, and are furnished with small reddish-violet flowers, of a clear colour, and faint but agreeable smell. The seeds, resembling little cylinders, are about a line long, and of an obtusely quadrangular figure.

The vegetable substance obtained from this plant under the name of indigo, is of a blue colour, and of a hard, brittle, and friable texture; it is chiefly used by dyers, and painters in water colours. Indigo was formerly considered, in Europe, as a kind of Indian stone; nor was its natural history well known, till after the discovery of America, and that the conquest of part of India had introduced the plant to our notice. Nevertheless, long before this period, it is pretty certain that the inhabitants of Arabia and of Egypt were acquainted with the secret of making indigo, but they carefully concealed the process from other nations. Burchard, in the *Description de l'Ile de Malta*, published in 1660, speaks of an indigo manufactory established in that island. He says that they grow a species of *glastum*, called by the Spaniards *anil*, and by the Arabs and Maltese *ennir*, from which they obtain a dye. The plant is very tender the first year, and the feculum which it yields is of a reddish colour, forming an imperfect kind of paste which sinks in water. This indigo is called *nouti* or *mouti:* that which is the produce of the second year they name *cyerce* or *ziarie:* this is violet, and floats in water. The indigo of the third year is of the least value; it forms a heavy paste of a dull colour, and is known by the name of *cateld.*

The manner in which the plant is made to yield this useful product is simple enough. After having cut a quantity of the shrub, the people employed for the purpose sink it in a cistern of water, where it is suffered to macerate for several days. When the water appears to be sufficiently impregnated with colouring matter, they draw it into another cistern, where it is well stirred with sticks; after which they suffer the water to run gently off, and the feculum that remains is spread on cloths and exposed to the sun. When it has remained long enough to acquire some consistence, it is formed into balls and tablets, and dried on the sand.

Different species of indigo plants grow spontaneously on the coast of Guinea. According to Wadstrom, they are more cultivated in that part of the world than even rice or millet. Several dyers, who have tried the African indigo, are of opinion that it is better than what comes from either the East Indies or Carolina. It is doubtful, however, if this is the case, at least with respect to the Indian, since the African negroes, notwithstanding the congenial nature of their climate, are not so expert at the manufactory of this substance as those of our islands. In Dahomy, a country situated in the interior of Guinea, and where the indigo plant is extremely common, the natives never trouble themselves to extract its colouring dye.

In Senegal the negroes make the indigo from a plant which they call *gangue*. They strip the leaves from the upper branches, and, pounding them into a fine paste, form them into rolls and dry them in the shade. In Madagascar the islanders prepare their indigo in the same manner. To make the dye, they bruise some of the rolls and put the powder into an earthen pot with water, where it is boiled a certain time. Into this dye, when cool, they dip their silk or cotton, which, when drawn out again, becomes of a fine deep blue.

Indigo grows naturally in several parts of Asia, which may truly be called its native country; and of the several kinds which are produced in this vast quarter of the world, those which grow in Hindostan are reckoned the best.

The manner of working this plant is not the same in all parts of Asia, nor do they always manufacture it alike in the same district. Among the different ways in which this product is obtained we may notice two; one distinguished by the name of inde, the other of indigo. In the manufactory of inde, they do not infuse the leaves in water alone, but put in all the plant, with the exception of the root, as in indigo.

The Chinese, when they prepare their indigo, take the stems and the leaves of the green herb, and throw them into a tub filled with a sufficient quantity of water. After having left the plant to macerate for twenty-four hours, they throw out the stem and leaves, and pour into each tub three or four measures called *gantang* of fine lime, passed through a sieve, which they stir briskly with sticks till they raise a purple foam. After this operation, it is left for a day to rest in the tub, then the water is drawn off, and the substance deposited dried in the sun. To facilitate the desiccation they divide the substance into square cakes, which being well dried, are in a proper state for transportation.

The method followed in Agra is this: After the rains in the month of June, and when the indigo is about a yard high, they cut it down, and put the plants into a vessel called a *tanch*, full of water. Here they remain for several days until the water has acquired a strong blue colour; then they pass the liquor into another vessel, and stir it with their hands. When the appearance of the froth assures them that the mass has been sufficiently agitated, they pour in a certain portion of oil, so as to cover all the blue matter. After the indigo is fallen to the bottom, they draw off the water, and, collecting the feculum, spread it on cloths which are laid on sandy earth. In this manner the indigo gradually dries; but while it yet retains some moisture, they mould it with their hands into balls, and complete the process by drying them in a warm place.

This blue matter is then in a state fit for sale. In Hindostan they call it *noti*; among the Portuguese, *boriga*. This indigo only holds a second place in point of quality; that being superior which is collected the year after from the shoots of the plant; this is named *tsjerri* by the Indians, and *cabeca* by the Portuguese. The third year they cut the plants again; but then they yield only an indigo of a bad quality, known by the name of *sassala*.

The *cabeca* is very blue, and of a fine clear colour; this substance, which is soft, and so light as to float on water, exhales with a violet fume, when laid on burning charcoal, and leaves but little ashes.

The *noti* or *boriga* is of a colour inclining to red, when examined against the sun. The *sassala* is very hard, and of a dull colour.

The indigo plant is cultivated on a large scale in America. In Carolina, in Louisiana, and in Mexico, it is produced in abundance; but no where with more success, or in greater quantities, than in the West Indies. There, in some of our islands, as well as those belonging to the French, it is one of the chief objects of commerce. It is attended with little expense, and returns a large profit, though less than that produced from the sugar plantation. The plant, as we have before observed, is tender, and very sensible of sudden alterations in the temperature of the air. This makes the chance of success more hazardous than in either the cotton or the coffee plantation, since a cutting wind may destroy in an hour what the planter has laboured for months to bring to perfection. Continued rains, without the proper means being contrived for the water to drain off; scorching winds that dry up the trunk; and, above all, a host of insects that feed upon the leaves, are amongst the catalogue of calamities to which the indigo is subject before it arrives at maturity. These obstacles, however, though they occur but too frequently, and certainly exercise the patience of the planter, do not seem to operate against the general cultivation of the vegetable. The harvest is always looked forward to as a reward for the losses which occur in raising the plants; and when it arrives, the cultivator is frequently repaid by an abundant crop for all his trouble.

The proper time for sowing the seeds of the indigo plant varies according to the situation of the place and the season of the year. In the flat part of the Cape they begin the most essential operation in November or December, in the time of the *norths*. In this part of the colony they give this appellation to the rains which fall at that season, and which come from that point of the horizon. These rains are soft and fine, resembling those which refresh our lands in the month of May, and their coming is announced to the cultivator by several infallible signs. They prepare the land for the reception of the seed, and the manner in which the natives proceed to this part of the business is as follows:

The majority of the negroes employed for this purpose arrange themselves in a row; and being provided with hoes, they together make shallow holes in the ground, for each of which one blow with the hoe is sufficient; after the first blow is struck, they move backwards and repeat the operation, going alternately from right to left and from left to right. Whilst this is about, others placed before them sow the grain with their hands, putting, at a guess, about eight or ten seeds into each hole. This part of the employment falls to the share of the old and feeble negroes of both sexes. A third party follow these, and cover the seeds either with a rake, or with a broom made on purpose.

The distance between each hole is generally about six or seven inches. When the seed is in good condition, and the rains favourable, the plants commonly make their appearance above-ground in three or four days, after which they are carefully weeded every fifteen or twenty days, till the indigo is high enough to shade the ground beneath it, and prevent the noxious plants from rising to its prejudice. The negroes weed the indigo with a kind of sickle, cutting off all those that are calculated to prove injurious to the young crop. In two or three months, if every thing goes on in a favourable manner, the plants will have arrived at maturity, and be fit to cut for the purpose of making indigo.

# NEPENTHES.

GYNANDRIA TETRANDRIA.

GENERIC CHARACTER.

Calyx divided into four roundish leaves.

Corolla none.

Seed-vessel oblong, truncated, divided into four chambers by as many valves, and containing a considerable number of sharp-pointed seeds.

SPECIFIC CHARACTER.

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|---|---|
| NEPENTHES DISTILLATORIA. | *Spec. Plant. Linn.* 3d ed. p. 1354. |
| | BANDARA ZEYLANICA, in extremo foliorum folliculum penicilliformem expansum habens. *Burm. Zeyl.* 42. t. 17. |
| | With an expanded little bag of a long shape at the end of each leaf. |
| | Urticaria vegetabilis zeylanensium. *Pluk.* |
| | Planta mirabilis distillatoria. *Grim. E. N. C. An.* 1. *Dec.* 2. p. 363. f. 363. |
| NEPENTHES. . . . . . | *Pluk. Alm.* 394. 237. f. 3. *Rumph. Amb.* 5. p. 121. t. 59. f. 2. |

THE nepenthes may justly be classed among the most singular productions of the vegetable world.

The plant has always excited the admiration of those who have examined its structure, with a view to the contrivance which is so strikingly exhibited in the formation of its leaves. The nepenthes is a native of India: it is an herbaceous plant, with thick roots, and a simple stem, crowned with flowers disposed in bunches. The leaves are alternate, partly embracing the stem at their base, and terminated by tendrils, each of which supports a deep, membranous urn, of an oblong shape, and closed by a little valve like the lid of a box. This appendage to the leaf appears to be as designed and studied a piece of mechanism as any thing we can meet with in Nature's more complicated productions. The leaf, as we have already said, is terminated by a deep oblong urn; this, in general, is filled with a sweet limpid water. In the morning the lid is closed, but it opens during the heat of the day, and a portion of the water evaporates; this is replenished in the night, and each morning the vessel is full, and the lid shut. The plant grows in a climate where the parched traveller is frequently in want of refreshment, and gladly avails himself of the water which this vegetable affords, each urn containing about the measure of half a wine glass. The use of this plant is too evident to need any comment. It is one of the many instances in nature of the bounty of Providence, who has filled the urns of the nepenthes with a treasure, of all others the most refreshing to the inhabitants of hot climates.

Whatever is sufficiently singular to raise our admiration, frequently becomes the object of superstition: this is the case with the nepenthes among the inhabitants of Madagascar, who believe that if they overturn one of these vessels of water no rain will fall on that day.

# BREAD-FRUIT TREE.

MONOECIA MONANDRIA.

GENERIC CHARACTER.

Male. Flowers in a cylindrical catkin.
Calyx none.
Corolla of two petals.

Female. Flowers without either calyx or corolla: germens, or seed-buds, numerous, and collected in the substance of a fleshy globe.

SPECIFIC CHARACTER.

ARTOCARPUS INCISA. A. foliis pinnatifido-sinuatis scabris subtus pubescentibus, amentis masculis cernuis. *Linn. Spec. Plant. Willd.* 4. p. 188. no. 1.

Leaves deeply gashed, rough, downy beneath: male catkins bending downwards.

RADEMACHIA INCISA. *Thunb. Act. Holm.* pl. 36. p. 250.

SOCCUS GRANOSUS. *Rumph. Amb.* 1. p. 112. pl. 33.

BREAD-FRUIT TREE. *Sonnerat. Itin. ad Nov. Guin.* pl. 57—60.

WE are informed by Dampier that in Guam, one of the Ladrone islands, " there is a certain fruit called the *bread-fruit*, growing on a tree as big as our large apple-trees, with dark leaves. The fruit is round, and grows on the boughs like apples, of the bigness of a good penny loaf; when ripe it turns yellow, soft, and sweet; but the natives take it green, and bake it in an oven till the rind is black; this they scrape off, and eat the inside, which is soft and white, like the inside of new baked bread, having neither seed nor stone; but if it is kept above twenty-four hours it is harsh. As this fruit is in season eight months in the year, the natives feed upon no other sort of bread during that time. They told us that all the Ladrone islands had plenty of it. I never heard of it in any other place."

This is nearly the same description of the plant which lord Anson has given in his Voyage, who found it growing in some of the Philippines as well as the Ladrone islands. Several voyagers have noticed the bread-fruit; but till captain Wallis returned from the South Seas, and captain Cook from his voyage round the world, its history was but imperfectly known. Rumphius describes the tree as an inhabitant of the eastern parts of Sumatra, and tells us that the natives call it *soccus*, and *soccum capas*.

From the account which our famous circumnavigator captain Cook has left behind him, we learn that this fruit not only serves as a substitute for bread among the inhabitants of Otaheite and the neighbouring islands, but also, variously dressed, composes the principal part of their food. It grows on a tree that is about the size of a middling oak;

its leaves are frequently a foot and a half long, of an oblong shape, deeply sinuated like those of the fig-tree, which they resemble in colour and consistence, and in the exsuding of a milky juice upon being broken. The fruit is about the size and shape of a new-born child's head; and the surface is reticulated, not much unlike a truffle; it is covered with a thin skin, and has a core about as big as the handle of a small knife. The eatable part lies between the skin and the core; it is as white as snow, and somewhat of the consistence of new bread; it must be roasted before it is eaten, being first divided into three or four parts; its taste is insipid, with a slight sweetness somewhat resembling that of the crumb of wheaten bread mixed with a Jerusalem artichoke. This fruit is also cooked in a kind of oven, which renders it soft, and something like a boiled potatoe; not quite so farinaceous as a good one, but more so than those of the middling sort. Of the bread-fruit they also make three dishes, by putting either water or the milk of the cocoa-nut to it, then beating it to a paste with a stone pestle, and afterwards mixing it with plantains, bananas, or the sour paste which they call *mahie*. The mahie, which is likewise made to serve as a succedaneum for ripe bread-fruit before the season comes on, is thus made: The fruit of the bread-tree is gathered just before it is perfectly ripe, and being laid on heaps is closely covered with leaves: in this state it undergoes a fermentation, and becomes disagreeably sweet; the core is then taken out entire, which is done by gently pulling out the stalk, and the rest of the fruit is thrown into a hole which is dug for that purpose, generally in the houses, and neatly lined on the bottom and sides with grass: the whole is then covered with leaves, and heavy stones laid upon them; in this state it undergoes a second fermentation, and becomes sour, after which it will suffer no change for many months. It is taken out of the hole as it is wanted for use; and being made into balls it is wrapped up in leaves and baked: after it is dressed, it will keep five or six weeks. It is eaten both cold and hot; and the natives seldom make a meal without it, though to Europeans it is full as disagreeable as a pickled olive when first tasted. The fruit itself is in season eight months in the year, and the mahie supplies the inhabitants during the other four.

This food is readily procured by the inhabitants of the islands where it abounds; the soil is naturally calculated to promote its growth, and all the trouble of gathering the bread consists in climbing the tree.

# PAPER MULBERRY.

MONOECIA TETRANDRIA.

GENERIC CHARACTER.

Male. Calyx divided into four parts.
Corolla none.

Female. Calyx of four roundish, obtuse divisions.
Corolla none.
The calyx, after the fecundation of the flower, becomes a little fleshy succulent berry, containing a single seed. Several of these berries uniting form the fruit.

SPECIFIC CHARACTER.

MORUS PAPYRIFERA. M. foliis palmatis, fructibus hispidis. *Linn. Spec. Plant.* 3d ed. p. 1399. no. 3.

Leaves palmated, fruit hairy.

MORUS SATIVA, foliis urticæ mortuæ cortice papyrifera. *Kæmpf. Amœn.* 471, pl. 472.

Morus papyrifera sativa japonica. *Seb. Thes.* 1. p 44. pl. 28. f. 3.

PAPER MULBERRY. . *Nouv. Dict. d' Hist. Nat.* 3. p. 498. pl. A 27. f. 3.

LAMARCK has taken this tree from its original situation in the Linnæan system, and formed it into a separate genus by the name of *papyrius*, of which this is the only species. It grows naturally in China and Japan, in which last place it is carefully cultivated by the inhabitants upon their hills and mountains. The Japanese find this tree of singular service to them: when the winter approaches they cut the young buds and take off the bark, which, after undergoing different preparations, is manufactured into paper.

This plant, according to Kæmpfer, is commonly known by the name of the paper mulberry of Asia, and the manner in which the Japanese proceed to extract their paper from it is as follows: Before the leaves fall, they cut the shoots of that year, and afterwards divide them into slips of about three feet each, which are tied in several bundles, in order either to be boiled, or spread on hot ashes. These bundles are placed upright in a large and deep copper closely shut down. The boiling is continued till the bark has shrunk from the wood and left it naked for the space of half an inch; then they take out the shoots and suffer them to cool, making a longitudinal incision in each so as to remove the bark. This, when dry, is carefully laid by, to be finally made into paper whenever it may be convenient.

To accomplish this purpose, they cleanse the bark in water, where it lies for three or four hours; after which they scrape off its brown skin, to clear it from the first green surface of the wood. At the same time, the strongest bark of the year is separated from the thinnest which covered the younger shoots; for this bark makes the whitest and best paper, while that which is manufactured from the other is neither of so good a colour nor of so strong a texture. Bark which has been kept for some years is only fit to make a paper of the worst quality, which is referred to the class of stained or defective goods.

When the bark is well cleaned, and arranged in order according to its quality, they boil it in a ley which has been previously passed through a filter. When this begins to boil, they stir it continually with a strong reed, and as soon as the matter separates into a kind of wadding or filamentous substance, the boiling ought to be stopped.

The boiling is succeeded by another operation, called washing, and this is said to be of singular importance in the manufacturing of the paper. If it is not continued long enough, the paper will be strong, but of a bad quality; if, on the contrary, the washing is carried to an improper length, the paper will indeed be very white, but at the same time it will be soft, greasy, and unfit to write upon. It is therefore necessary to know exactly how to conduct this part of the process; and the manner in which it is managed is nearly as follows: They put the substance to be washed into a basket which will admit the water on all sides: this they plunge into a river, and stir it about with violence till the matter contained within the basket is reduced to the form of tow or wool. The substance which is intended for the finer sort of paper they enclose in a linen cloth, in which it is washed like the other, but rather more softened by a further operation. The matter being sufficiently washed is deposited on a thick, well polished table, where it is well beat with hard wooden rollers, until it becomes a pulp like a paste made of flour and water.

After the beating is concluded, they put the pulp into a straight tub, and pour upon it a quantity of an infusion of rice, or else a mucous infusion of the root *orem*. This melange is carefully stirred with a thin reed, until the liquor becomes of a proper consistence, when it is drawn off into a more capacious tub: from this vessel the substance is finally raised leaf after leaf, in the form of paper; and it should be noticed that the prototype is not made of copper wire, but of rush.

The leaves of paper thus prepared are laid in a heap on a table: between the edges of each leaf they place a thin piece of rush, forming a little eminence, by means of which the leaves are distinguished from each other, and can be at any time, if necessary, removed separately. Every heap is covered by a little board adapted to the form and size of the leaves, on which is placed a light weight, that the leaves, which are very moist at first, may not be pressed into one mass. The weight, however, is afterwards increased till all the moisture is insensibly pressed from them.

In about two days they remove the weights, and those leaves which are yet moist are dried in the sun.

The whole of the business is finished by taking the different heaps and marking the borders, after which the leaves are pressed and sold.

It appears that the infusion of rice is highly necessary in the manufactory of the Japan paper, to give it the proper consistence and whiteness. The rice of the country is particularly adapted for the purpose, as it is whiter and more mucilaginous than that of any other part of Asia.

The male flowers of the paper mulberry grow in cylindrical catkins, while those in the female, by their reunion, assume a globular form. Each little flower that contributes to form the globe is situated close to its neighbour, being divided from it only by a scale; and every one has its proper calyx, formed of a small tube with four teeth: in the centre is placed the germ; it has a lateral and very long style terminated by a simple stigma.

This tree resembles the mulberry, not only in its figure, but in several useful properties which are common to both trees. Olivier de Serre observed, that the interior bark of the mulberry, macerated a certain time, yielded a silky matter, from which silk might be manufactured. M. de Larouviere, some time afterwards, extracted a vegetable silk from the young branches of the Japanese plant, after they had been soaked and beaten. This experiment proves, that the leaves of this plant, like those of the common mulberry, might be used to feed silk-worms. There exists another interesting analogy between the two plants, which was first noticed by

Faujas. That naturalist, having attentively considered the process by which the Japanese converted this vegetable into paper, conceived the possibility of manufacturing a similar substance from our European mulberry: this experiment he actually put in practice, and completely succeeded; forming a paper from it without even rejecting the exterior bark.

COCOA-NUT TREE.

Designed by W. Daniell.

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# COCOA-NUT TREE.

MONOECIA HEXANDRIA.

GENERIC CHARACTER.

Male. Calyx of three leaves.
Corolla of three petals.

Female. Calyx of two leaves.
Corolla of six petals.
Seed-vessel a fibrous husk, containing a large oval nut.

SPECIFIC CHARACTER.

COCOS NUCIFERA. C. inermis, frondibus pinnatis, foliolis replicatis ensiformibus. *Linn. Spec. Plant. Willd.* 4. p. 400.

Without thorns or prickles, leaf-stalk pinnated, leaves sword-shaped and bending back.

Coccus frondibus pinnatis, foliolis ensiformibus margine villosis. *Hort. Cliff.* 483.

Palma indica coccifera angulosa. *Bauh. Pin.* 502.

CALAPPA. *Rumph. Amb.* 1. p. 1. pl. 1, 2.

TENGA. *Rheed. Mal.* 1. p. 1. pl. 1—4.

COCOA-NUT TREE. *Jacq. Amer.* 277. t. 169. *Roxb. Corom.* 1. p. 52. pl. 73.

THIS tree is an inhabitant of India, Africa, and America: its trunk, which grows to the height of sixty feet, is crowned with a bunch of ten or twelve leaves, each leaf being from ten to fifteen feet long, and composed of a double range of flag-shaped leaflets. From the centre of these leaves rises a straight, pointed, tender bud, which the natives call *chou*, and which is reckoned a delicacy. At the lower part of the bunch of leaves, and close to the stem, may be seen a great, oval, and pointed sheath, from whence issues a panicle charged with yellow flowers, which in due time produces the well-known fruit. It is hardly necessary to say that this, in its husk, is about the size of a man's head, and that it contains a clear, white, and firm nut, which is very indigestible, and has but little taste: it contains a useful oil, however, which the natives extract and apply to several purposes. When the nut is half ripe it contains a considerable quantity of clear water, which is better known by the name of milk. This has a very pleasant smell, and a most agreeable taste. In a country where the heat of the sun is intense, and the ground frequently parched for want of moisture, the milk of this nut proves, from its coolness, a delightful and refreshing beverage.

The cocoa-nut tree is of slow growth; but to compensate for this it lives long, and regularly produces fruit three or four times a year. When the extremity of the young and tender sheath is cut off, there distills from the wound a sweet white liquor, of a very pleasant flavour, which the natives call *toddy.* Mr. Percival tells us, that in the island of Ceylon they procure this luxury by making a slit over-night, with a knife, in the top of the tree where the leaves shoot up; and that they hang a *chatty* or earthen pot from the branches, so as to receive the juice, which immediately begins to distill, and continues to do so till next morning, when the pot is removed.

This liquor makes a wholesome and cooling drink while it continues fresh; but this is not long, as it contains a quantity of sugar, and of course in the warm climate of Ceylon it soon ferments. In the course of twenty-four hours it becomes acid, and after a time proves intoxicating. This circumstance, however, does not lessen its value in the eyes of the inhabitants, who are then enabled to distill from it a spirit, which is said to be used by our English soldiers when they cannot procure arrack.

The manner in which the inhabitants reach the tops of the cocoa trees, for the purpose of procuring the *toddy*, is thus described by Mr. Percival: "It is surprising to see with what dexterity the natives climb those high, straight, and slender trees. They have many ways of facilitating their ascent. Sometimes they tie pieces of the long leaf, twisted together with ropes of hay, around the body of the tree, leaving the distance of about two feet between each piece, and thus forming for themselves a sort of ladder. Frequently they embrace the tree with their feet, and then tie both together by a rope passing round the ancles; at the same time they clasp the tree with their hands, and thus ascend, resting alternately on their ancles and their arms. Having gained the top of one tree, their agility and dexterity prevent them from having to renew their toil. By means of the adjoining branches, and some ropes fastened at different places for the purpose, they contrive to pass from one tree to another. I have seen them in this manner collect the toddy from a whole grove of cocoa trees without once descending; and their feats of agility on these occasions equalled any thing I have seen the most dexterous of our sailors perform among the rigging of a ship, and was scarcely outdone by the monkeys, the native inhabitants of these groves."

The different parts of the cocoa tree are applied to various purposes. The light porous substance which grows amongst the branches is manufactured into a kind of coarse cloth, which serves to wrap up goods and to make rice-bags. The outer rind of the nut is made into ropes of different descriptions, and into cables and cordage for their vessels: in short, wherever tow or hemp is used, this rind may be employed to advantage, and it has one quality which is even superior, it does not rot so soon. The branches, cut down, are formed into posts and rafters for the huts of the natives, while the leaves are employed to cover the roofs and repel the rain: these last are likewise made into mats, into baskets, and into other useful domestic utensils.

There is no part of this tree useless to mankind; and in those districts where they are careful to preserve it, the inhabitants refrain from cutting the *chou*, which, though a great delicacy, must be left entire, or the tree will infallibly suffer from the injury.

# CORK TREE.

MONOECIA POLYANDRIA.

GENERIC CHARACTER.

Male. Calyx of five divisions; segments acute and often cloven.

Corolla none.

Female. Calyx hemispherical; formed of numerous imbricated scales.

Seed-vessel none. Seed an egg-shaped nut, seated in an hemispherical cup.

SPECIFIC CHARACTER.

QUERCUS SUBER. Q. foliis ovato-oblongis, indivisis, subtus tomentosis; cortice rimoso fungoso. *Linn. Spec. Plant. Willd.* 4. p. 433.

Leaves oval-oblong, entire, and a little downy beneath; bark of a spongy nature and full of clefts.

Suber latifolium sempervirens. *Bauh. Pin.* 424.

CORK TREE. . . *Duhamel, Traité des Arbres,* 2. p. 291. pl. 80. *Blackw. Herb.* pl. 193.

THIS tree, which in its fructification exactly resembles the oak, and which is in fact a species of the same genus, is so sensible of cold, that Duhamel assures us it cannot bear the frosts of the northern provinces of France. According to this excellent French author, the cork tree is neither to be found in Sweden nor in Denmark, but flourishes abundantly in the warmer parts of France, near Condom, Nerac, and Bazas, as well as in Spain, in Italy, in Provence, and in Languedoc. In the hard winter of 1709, most of the cork trees were destroyed throughout these provinces; but the damage was in time repaired, and they at length became as numerous as before.

The various uses to which the bark of this tree is applied, are too well known to need enumerating. The acorns, which have a sweetish taste, not only serve to feed hogs and poultry, but are likewise useful to mankind; who, in the time of scarcity, have availed themselves of their aid. It is said that the Spaniards eat them roasted like chestnuts.

With respect to the manner of obtaining the cork from this tree, we have the following account from M. Duhamel:

When the trees have attained the age of twelve or fifteen years, they remove the bark for the first time; but the cork at this barking is only fit to burn. Seven or eight years after it is again removed, but yet it is far from being of a good quality, and is only used for buoys and other common purposes. This operation is repeated when the trees are about thirty years old, and then the bark is found to be of a superior nature, and fit for all the purposes to which cork is applied. It should be remarked, that the best bark is obtained from the oldest trees, and that the removal of this substance is far from proving injurious to the plant, since a cork tree which is barked every eight, nine, or ten years, will live for a century and a half, and sometimes longer.

In July and August the persons employed upon the cork trees begin their operations. The chief instrument that they use for the purpose of raising the bark, is a small hatchet, with a handle terminating in a wedge. With this instrument they slit the bark from the top of the tree to the bottom, and then make a circular incision at the two ends of the slit; after this is done the bark is well beaten with the back of the hatchet, in order to loosen it from the tree; and it is then raised by introducing under it the wedge-shaped handle, till the whole piece by degrees is detached from the wood. In this part of the business the people are careful not to damage the fine skin that adheres to the body of the tree, lest they should be deprived of a future harvest; for when this is removed, the cork ceases to grow again until it is re-established, and that does not happen for several years.

The cork is cut into pieces of four or five feet in length, and afterwards scraped to render its surface even. The pieces are then placed over burning coals in order to blacken them; and it is said that this operation at the same time closes the pores, and improves the quality of the cork. Duhamel observes, that all the pieces are washed, and then placed one upon the other, and loaded either with pieces of wood, or heavy stones, on purpose to flatten them.

Cork is sometimes prepared without burning, and in this case it is merely soaked in water to straighten it. But this preparation, which is called white cork, is by no means so much esteemed as the black. Good cork ought to be supple, elastic, neither ligneous nor porous, and of a reddish colour. That which inclines to a yellow tint is not of so good a quality, but the white is by far the worst of any.

The cork, when burnt in close vessels, yields a black powder, called *noir d'Espagne*, which is employed in the arts.

# FIR TREE.

## MONOECIA MONADELPHIA.

### GENERIC CHARACTER.

Male. Calyx of four scales.
Corolla none.

Female. Calyx. Cone somewhat egg-shaped, and composed of scales with two flowers in each.
Corolla none.
Seed-vessel none. Seed enclosed within the scales of the cone.

### SPECIFIC CHARACTER.

PINUS SYLVESTRIS. P. foliis geminis rigidis, conis ovato-conicis, longitudine foliorum subgeminis basi rotundatis. *Linn. Spec. Plant. Willd.* 4. p. 494. no. 1.

Leaves rigid and in pairs; cones the length of the leaves, frequently growing two together; of an ovate-conical shape, and roundish at the base.

P. foliis geminis rigidis, strobilis junioribus pedunculatis recurvatis dependentibus, antherarum crista exigua. *Lamb Monog.*

α PINUS RUBRA. *Mill. Dict.* no. 3.

β PINUS TARTARICA. *Mill. Dict.* no. 4.

SCOTCH FIR. . . *Duhamel, Traité des Arbres,* 2. p. 133. pl. 30.
*Evelyn's Sylva, by Hunter,* 1. p. 274.
*Blackw. Herb.* t. 190.

THIS tree is one of an extensive genus, well known for the great utility of its timber, as well as for the resinous substances which it affords. The different species for the most part grow to a considerable height, and are distributed over Europe, Asia, and America. Of the several kinds of pine found in the different parts of the world, that which we have chosen may be considered as one of the most useful.

The Scotch fir, or wild pine, grows naturally in the Highlands, where the trees propagate themselves, by the seeds which fall from their cones, without any care. It must not be understood, however, that this tree is confined to the Highlands because it has obtained, with us, the name of Scotch fir, since it is common in other countries, and from thence is likewise called the Russian pine, and the pine of Geneva. Large forests of this fir are found in Germany, and vast numbers of the species are scattered over the Alps, the Pyrenees, the mountains of Auvergne, and different parts of Switzerland. In both European and Asiatic Russia this tree abounds; we likewise meet with it in Lithuania, in Poland, and particularly in Norway, where hundreds of mills, turned by water, are erected to saw its timber into planks. Mr. Coxe has noticed this circumstance in his Northern Tour; in which he tells us that there are 136 privileged saw-mills at Christiania, and that in the environs of that city the planks and deals are superior to those sent from America, Russia, and from the different parts of the Baltic, because the trees grow on the rocks, and are therefore firmer, more compact, and less liable to rot than the others, which chiefly shoot from a sandy or loamy soil.

The timber of this kind of fir, which we call deal, is either red, yellow, or white, but generally the latter; and we are assured by Pallas, that it is from the Scotch fir that we obtain the best masts for our navy. The people employed for this purpose are careful to choose those trees which are remarkable for the beauty and height of their stems, and the yellowness of their bark. It is not in the midst of the forest, but on the skirts, that the finest trees are found, and these are commonly observed to grow in a coarse and rather moist sand. The best masts are said to come from Riga; and we learn from Mr. Coxe, that the trade carried on there, in this article in particular, is very beneficial to the town. "The burghers of Riga," says this gentleman, "send persons who are mast-brokers, into the Russian provinces, to mark the trees, which are purchased standing. They grow mostly on the districts which border on the Dnieper, are sent up that river to a landing-place, transported thirty versts to the Duna, are then formed into floats of from fifty to two hundred pieces, and descend the stream to Riga. The tree which produces the largest masts is the Scotch fir. Those pieces which are from eighteen to twenty-five inches in diameter, are called *masts*; under those dimensions *spars*, or, in England, Norway masts; because Norway exports no trees more than eighteen inches in diameter. The English merchants, who contract with government, buy the masts from the burghers of Riga; and great skill is required in distinguishing those that are sound throughout, from those which are in the least internally decayed. They are usually from seventy to eighty feet in length."

It is not from the *Pinus sylvestris* alone that good masts are obtained, since the Weymouth pine (*Pinus Strobus* Linn.) is almost as famous for this sort of merchandize. Large and extensive woods of these trees are to be found in America, between the forty-second and forty-fifth degree of northern latitude, where some of them are said to grow to the height of two hundred feet. They are occasionally found of a very large size; one of them, mentioned by Dr. Douglas as growing on the banks of the river Merimac in the year 1736, being seven feet eight inches in diameter at the lower end. The wood of this pine was considered of such utility, that a law was made in the ninth year of Queen Anne, to preserve the timber, and to encourage the growth of the trees in America.

Among the useful species of this genus may likewise be mentioned the larch, (*Pinus Larix* Linn.) which is a native of the Alps and Appenine mountains, but now become very common in this country. In Switzerland the inhabitants are said to cover the roofs of their houses with shingles made of larch. These are generally cut about a foot square, and half an inch in thickness, which they nail to the rafter. At first the roof appears white, but in two or three years it becomes of a jet black, and all the joints are stopped by the resin which the sun extracts from the pores of the wood. Thus is the roof rendered impenetrable to the wind and rain.

From this tree is obtained what we erroneously call *Venice turpentine*; and it has been remarked, as a singular circumstance, that the inner part of the wood yields a pure gum, scarcely inferior to gum arabic. From Dr. Hunter's notes on the larch, we learn that the turpentine flows, at first, without incision, and that when it has done dropping, the poor people, who wait in the fir woods, make incisions, at about two or three feet from the ground, into the trunk of the trees, and into these incisions they fix narrow troughs, about twenty inches long. The end of each trough is hollowed like a ladle; and in the middle is a small hole, for the turpentine to run into a receiver, which is placed below it. As the balsam runs from the tree, it passes along the sloping gutter, or trough, to the ladle, and from thence runs through the hole into the receiver. The people who gather it visit the trees morning and evening, from the end of May to September, to collect the turpentine out of the receivers. When it flows out of the tree, the turpentine is clear, like water, and of a yellowish white; but as it grows older it thickens, and becomes of a citron colour.

It is produced in the greatest abundance in the neighbourhood of Lyons in France, and in the valley of St. Martin, near Lucern, in Switzerland.

Great quantities of common turpentine are collected from the different kinds of fir, and particularly, we believe, from the spruce fir, (*Pinus Abies* Linn.) from which the Burgundy pitch is prepared. M. Duhamel describes the manner in which the turpentine is collected on the continent; and tells us, that every year, about the month of August, the Italian country-men, in the neighbourhood of the Alps, penetrate into the Swiss cantons where the firs abound, in order to obtain this useful commodity.

Each person, before he sets out on his journey, provides himself with a horn of tin terminating in a sharp point, and a bottle of the same metal, which he fastens to his girdle. These people, from the nature of their employment, and the mountainous country they have to explore, obtain a facility in climbing which nothing but practice could enable them to accomplish. They will mount in a very short time, to the tops of the highest firs, by means of cramp irons fixed to their shoes, which pierce the bark of the trees, while they embrace the trunk with their knees and one hand, the other being employed to carry the horn. The turpentine distills from little bladders, or tumours, which are found on the bark of these trees, and which the people burst with the sharp end of their horn. Into this vessel they collect the turpentine as it runs from the wound, and when the horn is full they empty it into the bottle which hangs to their girdle, and the contents of these bottles are again poured into others of larger dimensions made of goat skin, in which the turpentine is afterwards removed to the place of sale. It is singular that the tumours which are found under the bark, when they occur of an oval figure, have their longest diameter always horizontal, and never perpendicular.

The different species of this genus produce abundance of pitch, resin, and tar. For the manner in which each of these products is obtained we must again apply to M. Duhamel, who has given an excellent description of the process, chiefly from the remarks of M. Gaultier.

Neither all kinds of pines, nor all pines of the same species, produce an equal quantity of resinous juice. It is well known that some pines will yield three pints in one summer, while others will not afford half a gallon during the whole time they last. This difference does not seem to depend on the size, or on the age of the tree, or entirely on the nature of the soil, since it may be observed in the same forest; but in general it has been remarked, that trees with the thickest bark, and which have been most exposed to the heat of the sun, yield the greatest quantity.

The persons who are employed to collect the resin, usually choose such trees as are about four or five feet in circumference. At the foot of the tree they make a hole in the ground, eight or nine inches deep, which will contain nearly a quart of juice, and the earth is previously beat in order to render it less permeable; nevertheless a quantity of the juice will ooze through the new-made pits, and continue to do so till the resin, mixing with the earth, at length forms a mass sufficiently compact to resist any further transudation. It may be observed in this place, that in some countries they make a deep gash in the substance of the tree, near the ground, from which they collect a much purer resin than in the common way; but as this custom proves very injurious to the trees, they prefer the use of pits.

Notwithstanding all the care which is generally paid to cleaning the soil contiguous to the pits, sand, leaves, and fragments of bark, will inevitably collect in the latter, and render a filtering process afterwards necessary. When the pits have been properly prepared at the foot of the trees, and a little time before they make the incisions (which is towards the end of May), they strip off about six inches of the bark down to the *liber*. This precaution, it seems, is highly necessary, that the edge of the instrument employed to make the incisions may not be injured; for if any splinters or filaments should be left in the wounds, the course of the juice to the pits would be impeded: besides, in taking off the outer bark it is scarcely possible to prevent fragments from falling down, and mixing with the juice, if any should have been collected in the pits. The incision is made with a sharp adze, and the first wound is made near the foot of the tree, about four inches square, and an inch deep. From this there immediately oozes a resinous juice, which proceeds from between the bark and the *liber*, in the form of very transparent tears. Incisions are occasionally made from the end of May till September; and most juice is observed to be collected in the hottest time of the year. To facilitate the discharge of the sap, they enlarge the incisions every four or five days, and each time take off a thin slice of the wood, by which means an incision which, at the beginning of the season, was not more than four or five inches in diameter, will, by September, be increased to the size of a foot and a half, and to the depth of two or three inches.

In the following year the same operation is repeated, another wound being made in a similar manner; and thus they annually continue to collect the resin for twelve or fifteen years, each succeeding wound being higher than the former, and about a foot distant from the other.

When the pits are full the resinous juice is removed with iron or wooden ladles, and poured into buckets in order to be carried to a large trough, hollowed in the trunk of a pine, and capable of holding three or four barrels. When a sufficient quantity of resinous juice has been collected, it is reduced to the state of rosin; but before we explain this process, it may be necessary to observe, that the juice employed for this purpose is not so fluid, so transparent, or so fine in other respects, as that drawn from the larch and some particular kinds of fir. An essential oil is likewise drawn from it by distillation, which is known in Provence by the name of *esprit-de-raze*; but it is very inferior to the best spirit of turpentine.

The juice is reduced to a solid state in a copper containing about a hogshead, which is placed in a furnace built on purpose. In this the liquor is boiled for five or six hours, during which time it is continually stirred with a great wooden spatula, to prevent what settles at the bottom of the copper from burning. We are assured, if this precaution is neglected, the whole mass is liable to take fire; and when this happens, it is no easy matter to extinguish it. While the juice is boiling, they occasionally pour a small quantity on a slip of wood to try its consistence; and when they find that on cooling it crumbles between the fingers, they consider it as sufficiently reduced, and accordingly remove it from the copper. To accomplish this end, they place a trough supported on trestles close to the boiler, and strain the resin into it, through straw, that it may be purified from the filth and dirt with which it is always loaded notwithstanding every precaution is generally taken to keep the juice as clean as possible. When the mass begins to cool, but before it congeals, the people conduct it from the trough into barrels, where it becomes a hard, brown, and shining substance, known by the name of *colophony* or *rosin*, and used for many purposes.

When the resinous juice of the pine, thickened by boiling in the manner we have just described, is poured into a vessel containing a certain portion of cold water, and stirred briskly before it congeals, the substance changes from a brown to a fine yellow colour, and, in this state, is called *yellow resin*.

*Tar* is chiefly obtained from old pines by burning them in a close smothering heat. Great quantities of this unctuous substance are prepared in the different countries where fir trees abound, particularly in Norway, Sweden, Russia, Germany, and North America. For the purpose of extracting this useful material, a furnace is constructed in the form of an egg, and capable of holding a considerable quantity of wood. The furnace is not always built of the same size; but is generally adapted to the quantity of wood intended to be burnt at a time. In Le Vallais, where abundance of tar is prepared, the largest furnace that the country-people erect is about ten feet high, and five or six in diameter near the middle. The cavity is filled with billets of wood cut of a proper length, and placed in rows one upon the other. The upper layer is covered with turf, well pressed down, leaving only one place open for the purpose of introducing the fire to kindle the wood. When the billets are completely a-light, the tar begins to ooze from them, and, running to the bottom of the furnace, is carried from thence, through a pipe in the side, into a vessel placed on purpose to catch it. By this simple process all our tar is prepared, and may be said to consist merely of the resinous juice of the fir, blackened by the smoke to which it is exposed in its passage through the furnace. After all the tar is run off, the apertures of the furnace are carefully closed, and the whole left in this state for some days; after which it is opened, and the charcoal taken out.

*Pitch* is nothing more than tar reduced by evaporation, till it becomes a solid and tenacious mass.

Having thus described the manner in which these trees are made to yield their most valuable products, we shall conclude the article with a short account of the nourishment which some of the hardy northern people derive from them. We allude to the bark-bread, which Dr. Maton has noticed in his valuable additions to Mr. Lambert's splendid work on the pine trees. "We are informed by Linnæus," says this gentleman, "that the Laplanders eat, during a great part of the winter, and sometimes even during the whole year, a preparation of the inner bark of the pine, which is called among these people *bark-bread.* This substance is made in the following manner: After a selection of the tallest and least ramose trees, (for the dwarf branching ones contain too great a quantity of resinous juice) the dry and scaly external bark is carefully taken off, and the soft, white, fibrous, and succulent matter collected and dried. The time of the year chosen for the purpose is when the alburnum is soft, and spontaneously separates from the wood by very gentle pulling, otherwise too much labour would be required. When the natives are about to convert it to use, it is slowly baked on the coals, and, being then rendered more porous and hard, is ground into powder, which is kneaded with water into cakes, and baked in an oven."

The Siberian ermine-hunters likewise use the inner bark of the pine when the yeast which they carry with them to make their *quass* is spoiled by the cold. This substitute answers their purpose after it has been digested a certain time in water, over the fire; then mixed with rye-meal, and finally buried in the snow for twelve hours.

# CEDAR TREE.

SPECIFIC CHARACTER.

Pinus Cedrus. P. foliis fasciculatis rigidis perennantibus acutis, conis subglobosis, squamis truncatis appressis. *Linn. Spec. Plant. Willd.* 4. p. 501. no. 21.

Leaves in bundles; rigid, sharp-pointed, and permanent; cone of a subglobose shape, with truncated scales adhering close together.

Foliis fasciculatis perennantibus, strobilis ovatis obtusis erectis, squamis appressis rotundatis. *Lambert Monog.*

Larix Cedrus. *Mill. Dict.*

Cedrus Libani. *Barr. Icon.* 499. *Edw. Ornith.* pl. 188.

Cedar Tree. *Evel. Sylv.* 1786. 2. p. 1. pl. 1.

This tree, of which so much use is made in the manufactory of different articles, seems calculated by nature to bear almost any degree of heat or cold, and to thrive in almost any soil or situation. Mount Libanus, which was once supposed to be its only native place, has but very few trees remaining upon it; but the deficiency is made up in other parts, and we now find the cedar both in Europe and America, as well as in Asia.

It is singular that a plant of such a majestic appearance, and so well calculated to grow in bleak situations, should not have been more generally cultivated in this country, to adorn our barren mountains and break the dreariness of the prospect. The cedars thrive best in the poorest soil; and those in the physic garden at Chelsea may be quoted as a proof that their growth is not so slow as to make that a reasonable objection. Mr. Miller observes, that these trees were planted there in the year 1683, and were not, at that time, above three feet high; in 1774, two of the cedars were upwards of twelve feet and a half in girth, at two feet above the ground, and their branches extended more than twenty feet around their trunks.

Dr. Hunter, in his edition of Evelyn's Silva, has noticed some of the most remarkable trees of this species which have ever been produced in this country. "In the garden of the old palace at Enfield," says the doctor, "stands a cedar of Libanus of considerable stature. The body, exclusive of the bough, contains about 103 cubical feet. This tree was planted by Dr. Uvedale, who kept a flourishing boarding-school at the time of the great plague in 1665. It is in height about fifty-four feet at present *, eight feet having been broken off from its top by the high wind in 1703. Several other cedars of considerable size are scattered about in different parts of this kingdom. Of these, one of the most remarkable was blown down by the hurricane

* 1786.

that happened on the first of January, 1779. It grew on the north side of Hendon Place, eight miles from London. The height seventy feet; the diameter of the horizontal extent of the branches, one hundred; the circumference of the trunk, seven feet above the ground, sixteen; twelve feet above the ground, twenty-one. At this latter height it began to branch; and its limbs, about ten in number, were from six to twelve feet in circumference. This tree is supposed to have been two hundred years old, and planted in the reign of queen Elizabeth: tradition says, by her majesty herself. When blown down it was perfectly sound and undecayed, and seemed as if not grown to maturity. The following are the dimensions of a fine cedar growing at Hillington: The perpendicular height is 53 feet; the diameter of the horizontal extent of the branches from east to west, 96; from north to south, 89; the circumference of the trunk close to the ground, 13½; seven feet above the ground, 12½; twelve feet above the ground, 14 feet 8 inches; just under the branches, 15 feet 8 inches. It has two principal branches, one of which is bifid a foot and a half above its origin: before it divides, it measures in circumference 12 feet; after its division, one of its forks measures 8½ feet, the other 7 feet 10 inches. The other primary branch, at its origin, measures 10 feet; and soon dividing, throws out two secondary ones, each 5½. Its age is supposed to be 116 years."

The few cedars which are said to be still remaining on Mount Libanus are preserved with religious strictness. It is recorded, that upon the day of the Transfiguration, the patriarch of the Maronites (Christians inhabiting Mount Libanus), attended by a number of bishops, priests, and monks, and followed by five or six thousand of the religious from all parts, repairs to these cedars, and there celebrates that festival which is called "The feast of cedars." It appears that the patriarch officiates pontifically on this solemn occasion; that his followers are particularly mindful of the Blessed Virgin on this day, because the Scriptures compare her to the cedars of Lebanon; and that the same holy father threatens with ecclesiastical censure those who presume to hurt or diminish the cedars still remaining.

The peculiar and pleasant smell which cedar wood exhales is well known to every one; but this odour is not given the plant merely to gratify our senses; it makes the timber doubly valuable, for some purposes, by rendering it obnoxious to insects, which will neither pierce the wood nor enter a drawer of which it is composed. It is used to wainscot rooms and make staircases; and on account of its great durability, is admirably calculated for the use of the ship-builder. Vessels built with this wood will last for a great length of time, and may be used to advantage in the merchant service; but are not so well calculated for men of war, the wood being very brittle, and, of course, liable to splinter in every direction.

Several travellers have noticed the cedars of Lebanon, and mentioned their situation upon the mountains; but there are few upon whose accounts we can depend. When Rawolf travelled into Turkey in 1574, he saw twenty-six of these trees upon the mountain; but could not find any young ones to succeed them. In Maundrell's time, that is to say, more than a century afterwards, the number was reduced to sixteen; but later travellers assure us they have seen many of a small size distributed amongst the large ones. As a proof of the size to which these trees occasionally grow in their native soil, one of the largest was measured, and found to be thirty-six feet and a half in circumference, the branches at the same time covering a space of ground equal to a hundred and eleven feet in diameter: the stem is divided (about fifteen or twenty feet above the ground) into five branches, each of which is equal in size to a large arbour. According to Pocock, these famous cedars occupy the corner of a valley open to the north-east, and form a wood of about a mile in circumference, composed of trees of all sizes.

In the garden of the *Museum d'Histoire Naturelle*, there is a cedar which was planted by Bernard de Jussieu in 1734; this plant was measured by Desmaret on the twenty-fourth of June 1802, (an interval of sixty-eight years) and its circumference, four feet and a half above the ground, was found to be seven feet six inches, consequently its diameter is two feet seven inches four lines: thus this fine tree has increased in thickness about five lines and a half every year.

Notwithstanding what has been said respecting the durability of cedar-wood, we have reason to believe that it is not of a lasting nature; and, from what we can collect, it has probably been mistaken for a species of cypress; a plant belonging to another genus. If it ever possessed the properties recorded by our ancestors, it must have changed its nature; for at present the true cedar is considered as a perishable wood, of an inferior quality to good deal.

A resinous juice runs naturally from the cedar, which hardens into a transparent inflammable substance, of a yellowish colour. This resin is used by the Egyptians among the ingredients employed in embalming, and likewise to mix with other perfumes.

# TALLOW TREE.

MONOECIA MONADELPHIA.

GENERIC CHARACTER.

**Male.** Calyx five-toothed.
Corolla of five oblong petals.

**Female.** Calyx five leaves.
Corolla none.
Seed-vessel roundish, three-chambered; seed oval, large.

SPECIFIC CHARACTER.

CROTON SEBIFERUM. C. foliis rhombeo-rotundatis, utrinque mucronatis, integerrimis glabris. *Spec. Plant. Linn.* 3d ed. p. 1425. no. 9.

Leaves smooth, of a roundish rhomboidal shape, and spiny on both sides.

Euonymo affinis sinnarum, populi nigræ folio tricapsularis, granis nigris candidissima substantia obductis, sebifera. *Pluk. Amalth.* 76. t. 390. f. 2.

Arbor sebifera chinensis. *Kiu-yeu. Martin Le Compt. Am. Herb.* 375.

TALLOW TREE. . . *Pet. Gaz.* 53. t. 34. f. 3.

THIS extraordinary tree grows naturally in China, where it is met with on the banks of rivulets. It generally arrives at about the height of a pear-tree, resembles the cherry in its trunk and branches, and the black poplar in its foliage: there is this difference, however, in the wax tree; its leaves, which are of a bright red colour, are not toothed, and have two small glandules seated at the base of each. The fruit is contained in a husk divided into three spherical segments, which open when it is ripe, and discover three white grains, of the size of a small walnut.

The tallow tree is actually cultivated in several of the European colonies of both Indies, as well as in the southern parts of Europe. Besides the tallow which the Chinese obtain from this plant, they express a considerable quantity of oil from its seeds, which is principally used in their lamps. In order to obtain this vegetable fat, the people collect the pulp which covers the seeds, and which resembles tallow both in its colour, smell, and consistence: this is melted and made into candles, with the addition of a little linseed-oil, to render it softer and sweeter. Another method of extracting the tallow, very commonly employed, is to bruise the husks and seeds together; after which they are boiled in water, and the fat skimmed off as it rises to the surface: this, when it is suffered to cool and condense into tallow, is made into candles, after being mixed with a certain portion of linseed-oil, and a little wax to give it the necessary consistence.

It is said that if the Chinese had the art of purifying this fat in a proper manner, their candles would not be inferior to ours; but as it is, they have a more disagreeable smell, produce a thicker smoke, and give but a very inferior light.

## SYRINGE TREE.

MONOECIA MONADELPHIA.

GENERIC CHARACTER.

Male. Calyx of five divisions.
Corolla none.

Female. Calyx as in the male.
Corolla none.
Seed-vessel divided into three cells with one seed in each.

SPECIFIC CHARACTER.

Siphonia Cahuchu. *Linn. Spec. Plant. Willd.* 4. p. 567.

Jatropa elastica. J. foliis ternatis ellipticis integerrimis canis longe petiolatis. *Linn. Suppl.* 422.

Leaves oval, entire, growing three together at the end of a long stalk.

Hevea guianensis. *Aubl. Guian.* 2. p. 871. pl. 335.

Poa Seringa. *Act. Paris.* 1751. pl. 20. figura mala.

Syringe Tree. . . *Nouv. Dict. d'Hist. Nat.* 4. p. 308. pl. B. 1. f. 4.

This tree, which is well known for the valuable elastic resin which is produced from it, grows in the Brasils and in Guinea. This is the only species of the genus, and has been mentioned by several naturalists. Amongst others Aublet has noticed its fruit, and the milky and resinous juice which exudes from its trunk; but Richard, a French botanist, was the first who described the flower, no one before his time having paid any particular attention to that part of the plant. Each flower-stalk bears a great number of male flowers, with one solitary female placed at the top. Neither the one nor the other have any corolla; but there is a bell or cup-shaped calyx in the room of it, with five teeth. There are five stamens to each male flower, of which the filaments are united into a little cylindrical column, much shorter than the calyx, carrying their oval anthers a little below the summit of the column. The female flowers have no style, but merely a superior germ, of a globular and conical figure, upon which we find three flat stigmas. The fruit is a capsule consisting of three ligneous husks, each of which enclose two or three white seeds of a pleasant flavour, wrapped up in a thin and brittle coat.

This tree is described as very straight and tall. According to Aublet, it grows to the height of fifty or sixty feet. The trunk measures two feet and a half at the base, and the branches, which shoot out from the top, grow in all directions. The leaves are oval, thick, and tough; growing three together upon the same leaf-stalk, and having both surfaces glazed, but of a different colour, the superior surface being green, while the inferior is cinereous. There is a variety of this tree, consisting chiefly in the leaves being smaller, of a more pointed oval, and very thin.

The syringe tree, which has long been celebrated for its elastic resin, or caoutchouc, has been described by M. de la Condamine in a memoir, accompanied with a figure of the leaves and fruit, in the *Recueil de l'Academie des Sciences* for the year 1751, from which we learn that this academician found a considerable number of these trees in the forests of South America, to the north of Quito, where the natives of the country have given them the name of *heve*. When the tree is wounded, there exudes from the incision a white liquor, like milk, which gradually hardens in the air; of this the inhabitants make their flambeaux, which are about an inch and a half in diameter and two feet long. These flambeaux burn very well without any wick, and give a clear bright light; they exhale, during their consumption, a particular, but not disagreeable, smell, and one of them, we are assured, will continue to burn for twelve hours. In the province of Quito, they prepare their linen and canvass with this resin, so as to make it answer all the purposes of our oil-cloth.

Along the banks of the river Amazon, where this tree is not uncommon, the natives form the resin into rude figures of fruit, birds, and objects of different kinds. They likewise make their boots of it, which, being completely water-proof, are highly serviceable to the inhabitants of a country where the rains are heavy, and the plains intersected with rivulets. In the interior of the American continent the inhabitants mould the resin into bottles, to the necks of which they affix wooden pipes, and thus construct complete syringes; from whence the Portuguese of the colony of Para have called the tree *Poa de xiringa.* The wood of this singular vegetable production might be wrought into small masts, as it is both light and straight.

We learn from Bomare, that M. de la Borde, who travelled by order of the French government, in 1772, into the interior of Guinea, discovered this tree growing on the banks of lakes and rivers. They are not easily distinguished in the woods, from their tufted branches being intermixed with the surrounding foliage; but nevertheless, they may be detected by the quantity of young plants which are produced from the seeds, and which, after having increased to a certain size, are overshadowed by the forests, and perish for want of room and air.

The resinous juice of this tree, according to M. de la Borde, flows at all times of the year; but the rainy season is the most favourable for collecting it; and this is the time that the Indians choose for the purpose. They begin their operations by washing the foot of the tree to the height of seven or eight feet; then they bind the trunk below the place where they begin to wash, with a cord about the size of the little finger. This serves to support a layer of moist earth, in which they contrive a trench, and place in it a palm-leaf as a gutter, the end being immediately over a calabash resting on the ground. Having proceeded thus far, and disposed all things in order, they cut several gashes in the trunk of the tree, to the height of three feet, and the juice trickling from the wounds into the trench is carried along the palm-leaf, and falls into the calabash prepared for its reception. When the tree ceases to furnish this juice, the Indians proceed to a preparation which they are careful not to disclose; this is the manner in which they pour it upon the clay moulds, made on purpose, where it acquires that consistence and form which render it so applicable to the different purposes for which we require it in Europe.

In making a bottle or other vessel they are said to line the mould with the prepared juice while it is yet liquid, and expose it to a thick smoke till the lining becomes of a yellow colour; upon this they put a second layer, which is treated in the same manner; and they judge from experience when their vessel is of a proper thickness. When the resin is dry and hard, they pick out the clay and fill the elastic bottle with water, in order to wash out the pieces of the mould that may chance to remain in the cavity. In this state the substance, which is very flexible and almost insoluble, is called elastic gum.

Luke-warm water, or a heat of eighty or a hundred degrees, softens this substance, and softens it more or less according to its thickness; but never renders it fit to be moulded anew. This part of the process it would be highly gratifying to discover; and we should be tempted, were it in our power, to rob the Indians of their secret, that so valuable and singular a commodity might be moulded by Europeans.

Many different menstrua have been tried to dissolve this singular substance; but none seems to have succeeded completely except ether. This fluid dissolves it without any other heat than that of the atmosphere, and produces a transparent and amber-coloured solution. To succeed, however, in this operation, the ether must be of the very best quality. Spirit of turpentine appears to be the next best menstruum for this purpose, since with the assistance of heat it may be made to dissolve the elastic resin, provided only a small quantity, and that cut very thin, is exposed to the spirit, at a time.

# BETEL TREE.

MONOECIA MONADELPHIA.

GENERIC CHARACTER.

Male. Calyx bivalve.
Corolla of three stiff sharp-pointed petals.

Female. Calyx and corolla in the same sheath with the male.
Seed-vessel a thick, fibrous rind, enclosing an oval nut.

SPECIFIC CHARACTER.

ARECA CATECU. A. frondibus pinnatis: foliolis replicatis oppositis præmorsis. *Linn. Spec. Plant.* 3d ed. p. 1659.

Fronds pinnated; leaflets opposite, bent back, and very blunt at the ends.

Palma cujus fructus sessilis. *Faufel* dicitur. *Bauh. Pin.* 510.

Palma arecifera nucleo versicolore moschatæ simili. *Pluk. Alm.* 275. pl. 309. f. 4.

PINANGA. *Rumph. Amb.* 1. p. 26. t. 4.

CAUNGA. *Rheed. Mal.* 1. p. 9. pl. 5, 6, 7, 8.

BETEL TREE. . *Roxb. Corom.* 1. p. 54. pl. 75.

THE betel is a kind of palm, well known in India for the constant use which the inhabitants make

BETEL TREE.

Designed by W. Daniell.

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of its nut. This tree, which is remarkably tall, straight, and slender, is crowned with six or eight leaves, each about six feet long, and winged, or composed of two ranges of straight lanceolate leaflets, placed opposite to each other. The side of the common leaf-stalk is angular; and it expands at its base into a tough sheath, which encompasses the trunk of the tree, and is of so strong and close a texture, that the natives use it to hold their victuals, and to contain their arrack, which it does as effectually as a bladder. The nuts grow in clusters at the top of the tree, like those of the cocoa; but are not larger than a small hen's egg: between their outward bark and the stone, is contained a succulent and fibrous pulp, which the natives call *pinangue*, and which they mix occasionally with their betel; but the nut is the principal object of their attention, and these from their general use form a great article of traffic among them.

The areca or betel-nut is not chewed alone, but mixed with the leaf of a species of pepper, which, from being constantly used for this purpose, has obtained the name of betel-leaf; and the natives are said to prepare their areca by cutting it in slices, sprinkling it with slacked lime, and then wrapping it in some of these leaves. This preparation, when first chewed, tints the saliva of a fine reddish purple, which they eject, as it contains the greatest portion of the lime: the remainder they keep in their mouths as we do tobacco, till it no longer retains any flavour.

This mastication of betel is in general use in India, where it is introduced both morning and evening. They carry it with them when they visit, and offer it to those they meet. It serves to occupy the time, by filling up an idle hour, in the same manner as we use tobacco in Europe. Like the rest of the world, who can readily find an excuse for a favourite indulgence, they pretend that the stomach is strengthened, and the constitution improved, by the chewing of betel.

The inhabitants of the coast of Coromandel prepare their betel without lime; and indeed each district has its manner of seasoning their favourite relish, some mixing it with cardamoms and different aromatic drugs, while others make it still hotter by the addition of the most pungent spices.

The constant use of this luxury is so pernicious to the teeth, that the Indians frequently lose them before they are thirty years old. It is likewise highly injurious to asthmatic and phthisical persons. They use the timber of this tree for rafters to their houses, and for pales to fence in their grounds.

There is another species of this genus, the *Areca loeracea* Linn., inhabiting the Antilles, which is of considerable service to the natives on account of its durable wood. This, for about two inches from the exterior bark, is as hard as ebony; but towards the centre the wood is soft and spongy. There is a terminal bud growing from the centre of this tree, which is composed of the young leaves, and considered as a great delicacy by the natives, who tell us that it tastes like an artichoke. It is either eaten raw with pepper, dressed with a white sauce, or fried.

The Americans make use of the trunks of these trees for water-pipes and gutters; for both which purposes they are admirably calculated, on account of the hardness and durability of the wood. It is hardly necessary to remark, that the interior and spongy part is previously removed. This species of areca is also used, when split into planks, to inclose the negro huts and gardens. In short, it seems of general utility wherever it grows; and therefore it is to be lamented that the tree, from not being readily propagated, becomes daily more scarce, and will probably at length disappear.

# MANIHOT.

### MONOECIA MONADELPHIA.

#### GENERIC CHARACTER.

Male. Calyx none.
Corolla a single petal, divided on its edge into five roundish parts.

Female. Calyx none.
Corolla of five petals.
Seed-vessel divided into three cells with one seed in each.

#### SPECIFIC CHARACTER.

JATROPA MANIHOT. J. foliis indivisis tri-quinquelobo-palmatis integerrimis subtus glaucis. *Linn. Spec. Plant. Willd.* 4. p. 562.

Leaves palmated, green beneath, and divided into three or five lobes, all of which are entire.

J. foliis palmatis pentadactylis; radice conico-oblonga carne sublactea. *Brown, Jam.* 349.

Ricinus minor, viticis obtuso folio, caule verrucoso, flore pentapetalo albido, ex cujus radice tuberosa, succo venenato turgida, Americani panem conficiunt. *Sloan. Jam.* 41. *Hist.* 1. p. 130. pl. 85.

MANIHOT. . . . *Tourn. Inst.* 658. pl. 438. *Pluk. Alm.* 241. pl. 205. f. 1. *Mer. Surin.* 4. f. 4, 5.

THE manihot is a native of South America, of singular importance to the inhabitants, since its roots, properly prepared, afford them a very wholesome and nourishing food. The usual height of the plant is about six or seven feet; and the stem, which is covered with a shining green or reddish bark, is full of soft pith. The flowers are of a reddish or pale yellow colour, and spring from the axils of the leaves, or the bifurcations of the branches. The fruit is smooth, and composed of three husks, each containing a shining seed of a whitish gray colour, marked with little spots.

This useful shrub is cultivated in Asia, Africa, and America, particularly in the West Indies, where it proves of essential service to the negroes. It appears a paradox that any plant should yield a wholesome nutritious aliment, and secrete a mortal poison at the same time; yet this is the case with the manihot, though the different products are easily separated by a very simple process. To accomplish this it is only necessary to press out the venomous juice contained in the roots, and afterwards to dry the solid part, in order to convert it into flour, with which the negroes make their bread. We are assured that these people, notwithstanding their simplicity, are so certain to succeed in extracting the poisonous juice from this plant, that their bread never proves injurious to any one. They generally form the dry raspings of the root into flat cakes, called *cassave*, though, in several parts of America, they bake the raspings in grains or lumps, which are eaten in the same manner as rice.

Among the varieties of this shrub which are cultivated, those of a red or violet tinge are the most common, and are reckoned the most profitable. The internal part of the root is always perfectly white, as well as the poisonous juice, which has the appearance of milk. When the plants have arrived at a proper age, the negroes cut off the stems close to the ground and dig up the roots, which are carried to an out-house, and the bark pared off with a knife. These parings, after being washed and grated, are put into mats, or sacks, and exposed to the action of a strong press for several hours. In this manner the poisonous juice is sufficiently expressed from the wood, which is afterwards made into *cassave*. The manner in which this process is conducted is very simple: the grated root, in its prepared state, is laid on a plate of iron about two feet in diameter and half an inch in thickness. When this plate (which is supported on four feet for the purpose of lighting a fire under it) becomes hot, its surface is covered with the manihot root, which is very equally spread on the plate to the thickness of two fingers, and then flattened with a large wooden spatula. In this state it is left till the under side is sufficiently done, when it is merely turned, that both surfaces may be equally baked. The flat thin cake, which is thus formed, after being cooled in the air, acquires a firm consistence, and takes the name of cassave-bread.

The cassave is seldom eaten without a secondary preparation; this is merely to dip it in water or in broth, by which it is made to swell considerably, and in this state forms a solid and wholesome nourishment, which the inhabitants of many parts of South America, and particularly the negroes, prefer to other bread.

The juice which is expressed from the root of the manihot carries with it a very fine white fæculum, which falls to the bottom of the receiving vessel. When the juice is poured off, and this fæculum collected, it appears perfectly white, and feels between the fingers like starch. This kind of flour is used for the most delicate purposes, such as making of pastry and cakes. It is likewise manufactured into powder; and indeed appears to answer all the purposes of wheaten flour.

We have already noticed that the root of the manihot, besides its nutritive farina, contains a real poison. It is in the juice freshly expressed that this poison is to be found; and Dr. Fermin, while resident at Surinam, made several experiments to prove its deleterious effects. From these we learn that a moderate dose of the juice given to dogs or cats, kills them in about twenty-four minutes, and that an ounce and a half is sufficient to kill a dog of a middling size. The death of the animal is attended by the usual symptoms of poison, such as attempts to vomit, great anxiety, convulsive motions, an increased secretion of saliva, and abundant evacuations. On opening the body the juice which had been swallowed was found undiminished; it had not produced any vestige of inflammation in the stomach; no alteration in the viscera, nor any coagulation of the blood. From whence he infers that the poison acts entirely on the nervous system; and adds, that he cured a cat poisoned with this juice by giving her hot rape-oil till she brought it off her stomach.

Dr. Fermin supposes, with good reason, that the juice owes its venomous quality to a volatile matter. To prove this, he distilled fifty pounds of the juice by a gradual heat, and drew from this quantity three ounces of a spirit whose smell was insupportable. Having an opportunity to try the effect of this spirit on a condemned slave, he gave the unhappy wretch thirty-five drops, which were scarcely swallowed before he cried out most dreadfully, and writhed in every direction; this was followed by evacuations and convulsions, in which he died, after suffering extreme torture for six minutes. Three hours afterwards the body was opened, without finding any symptoms of inflammation; nor was any part injured, except the stomach, which was contracted to less than half its size.

# MANCINELLA.

MONOECIA MONADELPHIA.

GENERIC CHARACTER.

| | |
|---|---|
| Male. | Calyx of one leaf, bell-shaped, and notched at the end. |
| | Corolla none. |
| Female. | Calyx of three leaves. |
| | Corolla none. |
| | Pericarp pulpy, globose, containing a woody nut. |

SPECIFIC CHARACTER.

| | |
|---|---|
| Hippomane mancinella. | H. foliis ovatis serratis. *Spec. Plant. Linn. Willd.* 4. p. 571. |
| | With oval serrated leaves. |
| | H. arboreum lactescens, ramulis ternatis, petiolis glandula notatis. *Brown Jam.* 350. |
| | Juglandi affinis, arbor julifera lactescens venenata, pyrifolia. *Sloan. Jam.* 129. *Hist.* 2. p. 3. pl. 159. |
| | Malus Americana. *Comm. Hort.* 1. p. 131. pl. 58. |
| Mancinella. . . . . | *Catesb. Carol.* 1. p. 95. pl. 95. *Pluk. Phyt.* 142. f. 4. |

The mancinella is a poisonous tree, growing in the East Indies and in America. It is tall, very much branched, of a moderate thickness, and in its general appearance and foliage resembles a great pear tree. The leaves, the bark, and the wood of the mancinella, are full of a milky juice, which proves to be a most acrid and mortal poison. In this juice the Indians dip their arrows, when they intend to make them particularly fatal to their enemies; and as a proof of the great length of time which the poison retains its activity, we shall quote Bomare. This gentleman says that he saw it proved in the arsenal at Brussels, where the thigh of a dog was wounded with an arrow dipped in the juice; and although it was known to have been empoisoned about a hundred and forty years, yet it took effect, and killed the dog. The fresh juice is so acrid that a single drop will produce blisters on the skin, as if it had been burnt with a hot iron. Thus we may judge in some measure of the mischief it is capable of doing.

Formerly, before the Indians attempted to fell this tree, they made a fire of dry wood round it in order to dissipate some of the dangerous sap, and were very careful, during this operation, to avoid the noxious fumes. At present, however, the workmen are less cautious, and merely cover their faces with gauze, and their hands with gloves, that they may not be injured by any accidental drops of juice.

It has been the fate of the mancinella (like other wonderful productions) to have its effects exaggerated; and we are accordingly told that the very dew and rain which fall from its leaves are impregnated with poison, and that it is death to sleep beneath its shade. These accounts, however, are without foundation, since M. Du Tour informs us, that he has rested several times under this tree during more than two hours, and once while it rained, without having experienced any ill effects from its shade. Nevertheless, he thinks it very probable that the air in its immediate neighbourhood may not be wholesome, and therefore cautions the traveller against passing a night beneath the tree, or even sleeping within its influence in the day-time.

The mancinella is common in the West Indies, and on the American continent, where it is said to grow near the sea. It is singular that, in this situation, the trees are often surrounded by a vast number of crabs, for whose attendance it is very difficult to account, since they certainly are not attracted by the fruit, as that, from its poisonous quality, is not eaten by any animal. The wood of this tree is very durable, and of a beautiful grain. It is of an ash colour, veined with brown, and variegated with yellow. Different kinds of furniture, and particularly tables, are made of it, which are esteemed for their beauty, as the wood takes a high polish, and is veined like marble.

The best antidote against the poison of this tree is sweet oil; though some recommend a goblet of sea-water, taken immediately, as an effectual remedy.

# VALLISNERIA.

## DIOECIA DIANDRIA.

### GENERIC CHARACTER.

Male. Calyx a bipartite sheath.
Corolla of one petal divided into three parts.
Female. Calyx of three parts, divisions oval.
Corolla of three linear petals.
Pericarp cylindrical; containing many seeds.

### SPECIFIC CHARACTER.

VALLISNERIA SPIRALIS. *Linn. Spec. Plant.* p. 1441. ed. tert.
V. palustris, algæ folio; foliis in summitate denticulatis; flore purpurascente. *Mich. Gen.* 12. pl. 10. f. 1.
Leaves flag-shaped, toothed at their summits; flowers purple.

VALLISNERIA. . . . *Flor. Lapponica,* 371. *Hort. Cliff.* 454.

THIS plant has justly excited the attention of naturalists for the singularity of its mechanism. It is a native of Italy, where it flourishes in aquatic situations, and is said also to inhabit great part of Asia. The plant has nothing attractive in its appearance, nor any thing to recommend it to the eye of the casual observer; but when proper attention is paid to its curious formation, we cannot fail to be struck with the evident marks of contrivance which are manifested in the propagation of the species.

Nature has ordained that the male flowers should be produced at the bottom of the water, while the flower of the female plant floats on the surface, and is furnished with an elastic spiral stalk, which is connected to the root at the bottom, and extends or contracts as the water rises or falls. In rapid rivers this contrivance becomes especially necessary; and in the Rhone, where these plants are to be met with, the difference often amounts to several feet in a few hours, on account of the torrents which flow into it. The circumstance which so greatly raises our astonishment is this: the male flowers which are produced under water have the power to detach themselves from the plant and rise to the surface whenever the farina is ripe, where the female flowers are certain at that time to be in bloom, and ready to receive them.

Thus is this essential process conducted, and in this manner has Nature contrived to fulfil her intentions in situations where the difficulties to be encountered seem almost insurmountable.

# DATE TREE.

### DIOECIA TRIANDRIA.

#### GENERIC CHARACTER.

Male. Calyx a univalve tripartite spathe.
Corolla of three concave, oval petals.

Female. Calyx as in the male.
Corolla of three petals.
Pericarp an oval fruit, containing a single stony seed.

#### SPECIFIC CHARACTER.

PHŒNIX DACTYLIFERA. P. frondibus pinnatis: foliolis ensiformibus complicatis. *Linn. Spec. Plant.* ed. tert. p. 1658.

Fronds pinnate: leaflets sword-shaped and folded together.

Phœnix frondibus pinnatis; foliolis alternis ensiformibus basi complicatis, stipitibus compressis dorso rotundatis. *Hort. Cliff.* 482.

Palma dactylifera major vulgaris. *Sloan. Jam.* 174.

PALMA MAJOR. *Bauh. Pin.* 506.

DATE TREE. . . . . *Kæmph. Amœn.* pl. 1, 2. fig. 1, 2. (*male*) et pl. 1, 2. f. 2. 16. 11.

THIS celebrated tree is a species of the order of palms, and the only one of this genus that has been

DATE TREE.

*Designed by W. Daniell*

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hitherto discovered. It has for many ages been considered by the inhabitants of Asia and Africa as the most useful production of the vegetable kingdom: its fruit provides them with food during the greater part of the year, and its stem, branches and leaves, contribute to furnish them with necessaries.

The trunk of the date tree, which grows to the height of thirty or forty feet, is straight, simple, and cylindrical; it is thickly set on the upper part with scales, which are the vestiges of old leaves, and exist for many years after the leaves themselves have fallen off. The stem is terminated by an ample bunch of winged leaves, about nine or ten feet long, composed of two rows of leaflets, mostly alternate, and of an ensiform shape; the inferior leaves are short and spiny. The outside leaves spread out like an umbrella, and bend a little towards the earth; those in the neighbourhood of the centre are more elevated, and from the middle of them there shoots up a large, conical, and succulent bud, which by the natives is esteemed a delicacy. The bottom part of the tree produces a number of stalks about four or five feet high, which have been noticed by Adanson, who tells us that they spread the tree very considerably; so that wherever it naturally grows in forests, it is extremely difficult to open a passage through its prickly leaves. The fruit, which is shaped like an acorn, is composed of a thin light and glossy membrane, somewhat pellucid and yellowish; it contains a fine, soft, and pulpy fruit, which is firm, sweet, and somewhat vinous to the taste, esculent and wholesome: within this is enclosed a solid, tough, and hard kernel, of a pale gray colour, convex on one side, and furrowed on the other.

The date tree grows naturally, and is likewise cultivated, in the sandy parts of India, Arabia, and the northern parts of Africa, in the southern parts of Spain, and in the southern islands of the Mediterranean: it is also met with in France, on the borders of this sea; but the situation does not seem congenial to them, as they seldom bring their fruit to full maturity. It is chiefly in Arabia and in the country beyond Mount Atlas that it thrives in all its luxury, and produces the best fruit.

Desfontaines and Cavanilles are the best authors, among the moderns, that have described this useful tree; the first in his appendix to the *Flora Atlantica*, and the last in the second volume of his *Icones Plantarum*. To the former of these gentlemen we are chiefly indebted for the following observations respecting the manner of cultivating the tree in Barbary, and the different uses to which it is applied:—All that part of the Zaara which is near Mount Atlas, and the only part of this vast desert which is inhabited, produces very little corn; the soil, being sandy and burnt up by the sun, is almost entirely unfit for the cultivation of grain; the only production of that kind being a little barley, maize, and forgo. The date tree, however, supplies the deficiency of corn to the inhabitants of these countries, and furnishes them with almost the whole of their subsistence. They have flocks of sheep; but as they are not numerous, they preserve them for the sake of their wool: besides, the flesh of these animals is very unwholesome food in countries that are excessively warm; and these people, though ignorant, have probably been enabled by experience to know, that it was salutary for them to abstain from it. The date trees are planted without any order, at the distance of twelve feet one from the other, in the neighbourhood of rivulets and streams which issue from the sand. Forests of them may be seen here and there, some of which are several leagues in circumference. The extent of these plantations depends upon the quantity of water which can be procured to water them; for they require much moisture. All these forests are intermingled with orange-, almond-, pomegranate-, and especially vine-trees; which last twist round the trunks of the dates, and thus ripen their fruits by the heat of the climate, though they are never exposed to the sun. Dykes are erected along the rivulets and streams in the neighbourhood of the date trees, in order that the water may be conducted to refresh them by means of small canals. The number of canals is fixed for each individual; and the proprietors in some districts are obliged to pay an annual sum for the use of them, proportionable to the number and extent of their plantations. The date trees are watered in every season, but more particularly during the great heats of summer.

These trees are either raised from the seed, or by shoots which issue from the trunk or from the roots. When they are to be produced from seed, three or four of the hard nuts are put into a hole, in the spring: in about three or four months they begin to germinate, and soon afterwards push up a single leaf. The second year two or three make their appearance; and at length, before the third year is expired, the plant begins to resemble the parent tree, and show a few of the pinnate leaves.

But this method of raising the date is tedious, as the plants seldom bear fruit before they are twelve or fifteen years old; the Arabs, consequently, have almost entirely rejected this mode of cultivation, and adopted the other. The shoots which they select for this purpose, are from the best and most flourishing date trees; and they proceed by planting them at a small distance from each other. At the end of three or four years, if these shoots have been properly managed, they will begin to bear fruit; but in this stage of their growth, the fruit is dry, of a less agreeable flavour, and without any stones; they are considered, nevertheless, as equally nourishing, though they do not arrive at the highest degree of perfection till the plant has attained its fifteenth or twentieth year.

The date tree is long in coming to perfection; but then it amply repays the cultivator by its duration, since, according to the Arabs, it flourishes for two or three hundred years. The flowers make their appearance in the spring, and the fruit ripens in the autumn. The flowers burst from sheaths, from ten to twenty of which may be seen on each date tree; and these are cut off when the fruit has arrived at maturity.

This tree belongs to a class in which the male and female flowers grow on different plants; but the latter, being the most profitable, are chiefly cultivated. It is as singular as true, that unless the male plant is in the neighbourhood, the female will not produce; and for the purpose of insuring a crop, the Arabs make an incision in the trunk of each branch which they wish to produce fruit, and place in it a stalk of male flowers. Linnæus, who was well aware of this circumstance, mentions a female date tree which flowered many years at Berlin without producing any seeds; but the inhabitants of that place procured some of the blossoms of a male tree which was then growing at Leipsic, and thus procured fruit; which being afterwards planted by the celebrated professor, in his garden, sprung up, and were growing vigorously when he wrote the account. He likewise quotes Kæmpfer, who formerly told us how necessary it was found by the oriental people, who live upon the produce of palm trees, to place some of the male plants among the females, if they hoped for any fruit: hence it is the practice of those who make war in that part of the world, to cut down all the male palms, that a famine may afflict their proprietors; and this is even done by the inhabitants themselves when they dread an invasion, that they may cut off this resource from their enemies, and thus deprive them of their chief sustenance.

When the Arabs prepare the dates for food, they dry and harden them in the sun till they admit of being reduced into a powder, or kind of meal, which they carry with them into the desert; and which serves to nourish them while they are crossing those extensive and barren tracts. A kind of honey is also procured from them in some parts of the country; and this is effected by choosing the ripest and most juicy of the dates, which are put into a large jar with a hole in the bottom, and squeezed by placing a weight of several pounds over them. In this manner a honey or syrup is drawn from the fruit which drops through the hole, and is much esteemed by the rich inhabitants, who mostly leave the dried dates for the poorer sort. The date, in some shape or other, enters into the composition of most of their dishes, and proves a great blessing to a country where other food is by no means plentiful.

But it is not the fruit alone which renders the date so precious among the inhabitants of the East; since there is scarcely any part of the tree which is not useful. The wood, though of a spongy texture, lasts such a number of years, that the inhabitants of the country say it is incorruptible. They use it in constructing their houses, as well as for other purposes, and say that it burns slowly and without flame, but that the charcoal gives an intense heat.

The substance which is found in the centre of the young date trees is very nourishing, and has a sweet taste; the Arabs, who strip the bark and fibrous part off the tree in order to obtain this food, call it the marrow of the date. They eat also the leaves when they are young and tender, mixing them with lemon juice; the old ones are laid out to dry, and are employed for making mats and other works of the same kind, which are much used, and with which they carry on a considerable trade in the interior parts of the country. From the sides of the stumps of the branches, which have been left, arise a great number of delicate filaments, of which they make ropes, and from which it would be possible to manufacture a coarse kind of cloth.

We learn from Hasselquist, that the Egyptians make a conserve of fresh dates and sugar, which has a very pleasant taste. Before the fruit is ripe it is somewhat astringent; but when arrived at maturity it resembles the fig. A white liquor, known by the name of milk, is also obtained from this tree, by making incisions at the base of the leaves, during the greatest heat of summer, and suspending a vessel below in order to receive the liquor. The juice which flows at this time is of a sweet and agreeable taste, but must be used fresh, as it turns sour in the course of twenty-four hours. When this operation is frequently repeated, it exceedingly injures the tree; so much so, that we are assured the trees frequently decay, and that on this account they choose the old ones which have almost done bearing.

A considerable trade is carried on with dates in the interior parts of the country, and great quantities are exported to different parts of Europe. The crop is gathered about the end of November, and the bunches hung up in a dry place. The Senegal dates are shorter than those of Egypt, but are said to be superior in flavour to the best dates of the Levant.

# WAX TREE.

## DIOECIA TETRANDRIA.

### GENERIC CHARACTER.

**Male.** Calyx an oblong catkin, imbricated on all sides.
Corolla none.

**Female.** Calyx as in the male.
Corolla none.
Pericarp a berry, containing a single seed.

### SPECIFIC CHARACTER.

Myrica cerifera. M. foliis lanceolatis subserratis, caule arborescente. *Spec. Plant. Linn.* ed. tert. 1453.
Leaves lanceolate and slightly serrated: stem shrubby.
Myrtus brabanticæ similis caroliniensis baccifera, fructu racemoso sessili monopyreno. *Pluk. Alm.* 250. pl. 48. f. 9.

Wax Tree. . . . *Catesb. Carol.* 1. pl. 69.

This singular shrub is a native of North America, inhabiting Pennsylvania, Carolina, and Virginia. It produces a berry which yields the inhabitants of that part of the world a useful kind of wax; and the manner in which the natives proceed to gather and prepare this substance is described by M. Toscan in the following manner:

"Towards the end of autumn, when the berries are ripe, a man quits his house, with his family, and betakes himself to some island, or spot on the sea-coast, where the wax-trees grow in abundance. He carries with him pots for boiling the berries, and a hatchet for building a cabin to shelter him during his residence there, which usually continues three or four weeks; he then fells trees and constructs a hut, whilst his children gather the berries. A tree tolerably productive yields about seven pounds. When a sufficient quantity of berries is collected, the family employs itself in extracting the wax. A certain portion of the berries is put into the pot, and a sufficient quantity of water is poured on them, till it covers them for about six inches. The whole is then put on the fire and boiled; the berries being stirred, and pressed from time to time against the sides of the vessel in order to detach the wax from them. Soon after, it is seen floating on the surface in the form of grease, which is collected with a spoon, and strained through a coarse cloth, to separate any impurities that may be mixed with it. When these berries cease to yield any more wax, they are removed with a ladle, and fresh ones put into the same water. The same process is then repeated; and when a certain quantity of wax has been thus obtained, it is put to drain on a piece of linen, in order to separate the water which may be mixed with it. It is then dried and melted, after which it is strained a second time to render it perfectly pure, and finally made into cakes for use. Four pounds of berries yield about a pound of wax: that which is first detached is generally yellow; but in the latter boilings, the pellicle with which the stone of the berry is covered, gives it a green tinge.

The Chinese also collect wax from certain trees, which is almost equal in quality to that made by bees. As this, however, is not the produce of the vegetable, but deposited by insects, it may be thought improper to give it a place in this part of our work; nevertheless, as the wax is always confined to particular trees, that derive their name, in the country, from this circumstance, we shall beg leave to introduce them under the same head.

Only two kinds of trees produce the wax, which from its whiteness is called *pe-la*. One of these trees, which the Chinese call *kan-la-chu*, or the dry wax-bearing tree, is short and bushy, and grows in a sandy soil; the other, named *choui-la-chu*, or the aquatic wax-bearing tree, is much larger, and grows only in moist places. Grosier tells us that the former of these trees, being of a shrubby nature, is easily propagated; and that walls may be covered with it to the height of ten or twelve feet; or hedges may be formed of it in the fields: it seems indeed particularly calculated to succeed in any situation, since it is said equally to endure heat and cold, and to thrive, without the least culture, in the barrenest soil.

According to the account which the Abbé Grosier has given of this wax, and to which we are chiefly indebted for what follows, the small insects that make the *pe-la* do not naturally frequent the trees which we have just mentioned, but must be placed upon them: this, however, is not a difficult operation; and after a tree has been once stocked, it always retains them. Towards the beginning of winter, small tumours are perceived upon the *kan-la-chu* that have already produced wax, which continually increase, till they become of the size of a small walnut: these are so many nests filled with the eggs of those little insects, which in the country are called *pe-la-tchong*, or *la-tchong*. As soon as the tree begins to shoot forth its blossom, the insects crawl from their eggs; and this is the proper time to deposit nests on those trees that have none. The Chinese make small packets or bundles of straw, on each of which they put seven or eight nests; they afterwards tie these packets to the branches, taking care to place the nests immediately on the bark. If the shrub is five feet in height, it is capable of supporting one or two packets on each of its boughs; and the same of its branches in proportion to their size and vigour. After these insects are hatched, they run upon the branches, disperse themselves over the leaves, and perforate the bark, under which they retire; but always come forth at the proper season for making the wax.

It is about the middle of June, continues the

Abbé, that this wax begins to appear upon the *kan-la-chu*. At first a few filaments, like those of fine soft wool, are perceived rising from the bark, around the body of the insect; but by degrees these filaments form a kind of down, which continually becomes thicker, and increases more and more in size, during the heats of summer. This crust entirely covers the insect, and defends it, not only from the heat, but also from the rain and ants. The Chinese assure us, that, if the wax were left too long on the tree, the insects would not make their nests; on which account they are careful to gather it before the first hoar frosts in September.

The wax thus produced is carried to court, and reserved for the use of the emperor, princes, and chief mandarins. It is considered as a precious commodity, and esteemed for many virtues. The physicians prescribe it for several diseases; and when applied to wounds it is said to make the flesh heal in a very short time. It is supposed to be possessed of great power in nervous affections, and is swallowed in considerable quantity by the Chinese when they are about to speak in public, or have occasion, at any time, to exert an extraordinary degree of firmness and resolution.

# FAN-LEAVED PALM.

DIOECIA HEXANDRIA.

GENERIC CHARACTER.

Male. Calyx a compound sheath.
Corolla of three parts; petals oval and concave.

Female. Calyx a sheath as in the male.
Corolla of three parts; petals roundish.
Pericarp a roundish obtuse berry, containing three seeds.

SPECIFIC CHARACTER.

BORASSUS FLABELLIFER. B. frondibus palmatis plicatis cucullatis, stipitibus serratis. *Linn. Spec. Plant.* 3d ed. p. 1657.

Leaves hand-shaped, folded like a fan, wide at top, and drawn to a point below; leaf-stalk serrated.

Borassus frondibus palmatis. *Fl. Zeyl.* 395.

Palma coccifera, folio plicatili flabelliformi; mas, femina. *Raij Hist.* 1366.

FAN-LEAVED PALM. . . *Rheed. Mal.* 1. pl. 9, 10. *Rumph. Amb.* 1. p. 45. pl. 10.

THIS tree, which belongs to the family of palms, is remarkable for the shape of its leaves and of its

FAN-LEAVED PALM.

*Designed by W. Daniell.*

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fruit; the former exactly resemble the green candle-shades which are now made to slide within a hollow stick, and the latter represent the posteriors of a large animal.

The borassus is a native of India, where it grows to the height of thirty feet, and is crowned with a bunch of fan-shaped leaves, each of which is five or six feet long, and supported on a stalk, armed on each side with a row of spines. It is said to produce fruit but once during the time of its existence: this seems to be the final operation of Nature; for we are assured that soon after the fructuation is accomplished, the tree loses its vigour and gradually decays.

This palm tree is highly prized by the natives of India, on account of its great utility: they draw from it a very agreeable liquor, susceptible of vinous fermentation, from which they either distill a spirit, or, by evaporation, obtain a sugar. The wood is of a black colour, variegated with veins of a yellowish tint. It is used in the building of their houses, in several parts of their furniture, and for some of their domestic utensils. For all these purposes it seems admirably calculated; since, like the rest of the palms, it is of a very hard nature, and exceedingly durable. The leaves are also put to many uses; with these, when entire, they cover their houses, and make their screens and parasols: when divided into slips, they are made into mats which serve for different purposes; and finally, when cut in small pieces, they use them as a substitute for writing-paper.

The fruit of the borassus has been known from time immemorial by the name of the Coco of the Maldives. Many of the trees grow in those islands, where the inhabitants prize the fruit on account of several valuable properties, of which the principal is its power to preserve them against all kinds of poison. The belief of this power in the fruit is so strongly impressed on their minds, that they are said to sell it at a very dear rate to their neighbours, for similar purposes.

BANANA.

*Designed by W. Daniell.*

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# BANANA TREE.

## POLYGAMIA MONOECIA.

### GENERIC CHARACTER.

Calyx a large many-flowered sheath.
Corolla an irregular petal divided into two lips.
Pericarp a long fleshy fruit.

### SPECIFIC CHARACTER.

MUSA SAPIENTUM. M. spadice nutante, floribus masculis deciduis. *Linn. Spec. Plant.* 2. p. 1477.
Sheath nodding, male flowers deciduous.
Musa spadice nutante, fructu breviore oblongo. *Brown. Jam.* 363.
Musa caudice maculato, fructu recto rotundo breviore odorato. *Sloan. Jam.* 192. *Hist.* 2. p. 147.

BANANA TREE. . *Trav. Ehret.* 4. pl. 21, 22, 23. *Sted. Sur.* 2. p. 372.

THIS and the plantain tree (*musa paradisiaca*) are well known to the inhabitants of the West India islands, who cultivate them on an extensive scale for the sake of their nourishing fruit. The two plants are so connected together, in point of utility as well as form, that the description of one is necessarily followed by that of the other. The French distinguish the two species by the different shape of the fruit; one they call the banana with long fruit, the other the banana with round. The first, or plantain, properly so called, rises with a soft stalk fifteen or twenty feet high, the lower part of which is frequently as large as a man's thigh. A bunch of large leaves bursts from the top of the stem, and spreads over it on every side. These leaves are seven or eight feet long, and two or three broad: they are said to be rolled up in a kind of sheath before they make their appearance, and that in this state their growth is so amazingly quick, that they may be seen to rise towards the top of the stem with the naked eye. While they are pushing up in this manner, if a fine line is drawn across, level with the top of the leaf, in an hour's time the leaf will be near an inch above it. When the plant is arrived at its full size, a spike of flowers will be seen to push up from its centre, which is often near four feet in length, and bends downwards on one side. The fruit, or plantains, which proceed from these, are about a foot long, and an inch and a half or two inches in diameter: they consist of a green, or, when ripe, of a yellowish skin, containing a soft pulpy substance of a luscious flavour. The plantain spikes, when well loaded with fruit, are often so large as to weigh forty pounds each, and the food they yield the natives is so nutritious, that Dr. Wright says, without this fruit, the island of

Jamaica, where it is cultivated in great quantities, would scarcely be habitable, as no species of provision could supply its place, or so well enable the negro to fulfil the laborious task allotted to him.

The banana differs from the plantain in having its stalks marked with dark purple stripes, and spots; its fruit too is neither so long nor so much curved; it is likewise of a rounder shape, and its flesh is of a firmer consistence and more luscious flavour. The leaves, which are of equal length with the other species, frequently contain in their substance a great quantity of water, which issues out upon a small incision being made in the tree, at their base. The body of the banana is exceedingly porous, and perishes to the roots every autumn, pushing up a new stem the following spring. The fruit of this tree is so essential to the inhabitants of the tropical climates where it grows, that they never go to a distance without taking a quantity of it with them. Labat tells us, that when the natives of the West Indies undertake a voyage, they make provision of a paste of banana; which, in case of need, serves them for nourishment and drink; for this purpose they take ripe bananas, and, having squeezed them through a fine sieve, form the solid fruit into small loaves, which are dried in the sun, or in hot ashes, after being previously wrapped up in the leaves of Indian flowering reed. When they would make use of this paste they dissolve it in water, which is very easily done; and the liquor, thereby rendered thick, has an agreeable acid taste imparted to it, which makes it both refreshing and nourishing.

The fruit of the banana is eaten in different ways: when gathered fresh from the tree it forms a wholesome and cooling food; but although the natives are very fond of it in this state, it is more frequently fried in slices as fritters, or roasted in hot cinders, or boiled in the same kettle with their salt meat. In any way it is easily digested, unless eaten to excess. When the fruit is cut transversely, something like the figure of a cross appears imprinted in the centre: this has made the banana greatly esteemed, and even venerated, by the natives of Madeira, who call it the forbidden fruit, and reckon it a crime of the first magnitude to cut it with a knife.

The stems of the bananas, which are thick and herbaceous, preserve their moisture for a considerable time after they have been cut down, which is generally done every year after they have produced their fruit. With these stems the inhabitants feed their cattle and sheep, who are very fond of them. The plantations of bananas, which are very extensive in the West Indies, are subject to two considerable drawbacks; the first is from those dreadful hurricanes which are but too common in that part of the world, and which sweep down all before them; and the other from the perishable nature of the fruit, which ripening in great abundance at a certain time of the year, soon rots, and will hardly bear to be removed to any distance. This has induced M. Badier of Guadaloupe to suggest two methods of drying it, which he has described as being calculated to succeed very well.

The leaves of the banana, as well as the fruit, are of service to the inhabitants of the Indies; and amongst the varieties of the plant which are there cultivated, that called the *hog-banana* is particularly useful. The natives of the Molucca Islands make the leaves of this kind serve for napkins and table-cloths; they likewise polish them, when dry, so as to give them the appearance of a fine brown paper; and it is with these leaves that they make the little rollers in which they wrap up their tobacco. But they apply them to a still better purpose; for they contrive to write their letters upon this brittle paper, which of course cannot be lasting. The heart of the flower-stalks of this sort of banana is cut in pieces, and given to the hogs.

There is another variety of singular service to the inhabitants of some parts of India, since they contrive to draw a thread from the base of the leaves, of which they make two sorts of cloth, of a yellowish colour, and nearly as good as that from raw hemp. The most common sort they make into clothing, after it has been dyed black, red, or yellow: the other, which is of a fine texture, and shines like silk, they either dye black, or paint with a variety of figures of animals and flowers; and thus make an elegant covering for their beds or sofas. From the exterior and filamentous part of the plant they get their cordage and cables; and it is from this plant that the natives of Manado make their bags and hammocks.

Thus is the banana proved to be of the most essential service to mankind. In those climates that are congenial to its nature it propagates abundantly, and is of more use than the cocoa-nut, inasmuch as it is more generally diffused. Its fruit likewise is of far more consequence, since it contributes so largely to the nourishment of the natives. It may indeed be said to form their first food, at least in that part of the country where the rice is scarce. Infants at the breast are fed with the roasted fruit, which the mother forms into a pap, by first chewing it in her own mouth, and then passing it into the child's.

The *ensete*, a plant described and figured by Mr. Bruce, has been supposed by some to be a species of musa, though the Abyssinian traveller is not of the same opinion. The *ensete* is a native of Narea, where it grows in the great marshes and swamps for which that province is remarkable. This, as well as the coffee tree, is said to have been unknown in Abyssinia before the arrival of the Galla, a neighbouring people, who imported them at the same time. It comes to great perfection about Gondar; but the principal plantations of it are in that part of Maitsha and Goutto, to the west of the Nile, where it is almost the only food of the Galla, who inhabit that country. Indeed, if it were not for this plant, they would be miserably off for vegetable food, since, Maitsha being almost upon a level, the rains are apt to stagnate, and prevent the sowing of grain. As this plant is one of those rarities which Mr. Bruce considers as totally distinct from any other, and not belonging to the same genus as the banana, notwithstanding what botanists may say to the contrary, we shall conclude this account with his observations on the subject:

"Some who have seen my drawing of this plant, and at the same time found the banana in many parts of the East, have thought the ensete to be a species of musa. This, however, I imagine, is without any sort of reason. It is true, the leaf of the banana resembles that of the ensete; it bears figs, and has an excrescence from its trunk, which is terminated by a conical figure, chiefly differing from the ensete in size and quantity of parts: but the figs of the banana are in shape of a cucumber; and this is the part which is eaten. This fig is sweet, though mealy, and of a taste highly agreeable. It is supposed to have no seeds, though in fact there are four small black seeds in every fig belonging to it. But the figs of the ensete are not eatable; they are of a tender, soft substance; watery, tasteless, and in colour and consistence similar to a rotten apricot: they are of a conical form, crooked a little at the lower end, about an inch and a half in length, and an inch in breadth where thickest. In the inside of these is a large stone, half an inch long, of the shape of a bean, or cashoo-nut, of a dark brown colour; and this contains a small seed, which is seldom hardened into fruit, but consists only of skin.

"The long stalk that bears the figs of the ensete springs from the centre of the plant, or rather is the body or solid part of the plant itself. Upon this, where it begins to bend, are a parcel of loose leaves, then grows the fig upon the body of the plant without any stalk; after which the top of the stalk is thick set with small leaves, in the midst of which it terminates the flower in form of the artichoke: whereas in the banana, the flower, in form of the artichoke, grows at the end of that shoot or stalk which proceeds from the middle of the plant, the upper part of which bears the row of figs. The leaves of the ensete are a web of longitudinal fibres closely set together; the leaves grow from the bottom, and are without stalks: whereas the banana is in shape like a tree, and has been mistaken for such. One half of it is divided into a stem, the other is a head formed of leaves; and in place of the stem that grows out of the ensete, a number of leaves rolled together round like a truncheon, shoots out of the heart of the banana, and renews the upper as the under leaves fall off: but all the leaves of the banana have a long stalk; this fixes them to the trunk, which they do not embrace by a broad base, or involucrum, as the ensete does.

"But the greatest differences are still remaining: the banana has, by some, been mistaken for a tree of the palmaceous tribe, for no other reason but a kind of similarity in producing the fruit on an excrescence, or stalk, growing from the heart of the stem; but still the musa is neither woody nor perennial; it bears fruit but once; and in all respects it differs from trees of the palmaceous kind, and indeed from all sorts of trees whatever. The ensete, on the contrary, has no naked stem, no part of it is woody; the body of it, for several feet high, is esculent; but no part of the banana can be eaten. As soon as the stalk of the ensete appears perfect and full of leaves, the body of the plant turns hard and fibrous, and is no longer eatable; before, it is the best of all vegetables. When boiled it has the taste of the best new wheat-bread not perfectly baked.

"When you make use of the ensete for eating, you cut it immediately above the small detached roots, and perhaps a foot or two higher, as the plant is of age. You strip the green from the upper part till it becomes white; when soft, like a turnip well boiled, if eat with milk or butter, it is the best of all food, wholesome, nourishing, and easily digested."

What follows is chiefly to prove, that notwithstanding the figure of the banana occurs among the Egyptian hieroglyphics, yet it is merely adventitious in Egypt, and is really a native of Syria.

# SUGAR MAPLE.

POLYGAMIA MONOECIA.

GENERIC CHARACTER.

Calyx of one leaf with five divisions.
Corolla of five oval petals.
Seed-vessels united at the base; roundish, compressed, each terminated by a large membranaceous wing, and containing a solitary seed.

SPECIFIC CHARACTER.

| | |
|---|---|
| ACER SACCHARINUM. | A. foliis quinquepartito-palmatis, acuminato-dentatis. *Linn. Spec. Plant.* ed. tert. 1496. |
| | Leaves hand-shaped, sharply toothed, and divided into five parts. |
| SUGAR MAPLE TREE. | *Amer. Phil. Trans.* 3. p. 64. |

WE are indebted to Dr. Benjamin Rush, professor of the Institute and of clinical medicine in the university of Pennsylvania, for an excellent account of the manner in which the sugar is procured from this useful plant, as well as for some observations on the nutritive qualities of that aliment. In the following description, therefore, we shall avail ourselves of his assistance, and introduce as much of his account as is sufficient for our purpose.

The sugar maple tree grows in great quantities in the western countries of all the middle states of North America; but those of New York and Pennsylvania are said to yield the most sugar. They sometimes form thick groves of five or six acres; but are generally interspersed with some of the common forest trees. They are chiefly found in the richest soils, and in the neighbourhood of the purest streams.

The sugar maple is supposed to arrive at its full growth in the woods in twenty years; it is then as tall as an oak, and from two to three feet in diameter; the beautiful white blossom which it puts forth before a single leaf makes its appearance, is sufficient to distinguish it immediately from the rest of its companions. The sugar with which the small branches are impregnated affords the cattle and sheep a considerable share of nourishment during the winter season; and, according to Dr. Rush, was what the domestic animals belonging to the first settlers chiefly subsisted upon in that inclement season, before they were able to supply its place by the cultivation of forage.

It is a happy circumstance that this maple tree, far from being injured by tapping, is improved by it, so that a single tree has not only survived, but flourished, after forty-two tappings in the same number of years. The oftener it is tapped the more sugar is obtained from it; and the doctor observes, that the annual discharge from the tree, in improving and increasing the sap, is demonstrated from the superior excellence of those trees which have been perforated in a hundred places by a small wood-pecker, which feeds upon the juice. The sap of these trees is much sweeter to the taste than that which is obtained from trees which have not been previously wounded, and it affords more sugar.

The season for tapping the trees is in February, March, and April, according to the weather which occurs in these months; and a tree of an ordinary size will yield, in a good season, from twenty to thirty gallons of sap, from which are made from four to five pounds of sugar. The temperature of the air has such an influence on the circulation of the sap, that the quantity discharged from a wounded tree in the course of four-and-twenty hours, will vary from five gallons to a pint, and will totally cease in the night if a frost should chance to succeed a warm day. Dr. Rush has thus described the manner in which the juice is collected: "The perforation in the tree is made with an axe or an auger: the latter is preferred, from experience of its advantages. The auger is introduced about three quarters of an inch, and in an ascending direction, (that the sap may not be frozen in a slow current in the mornings or evenings,) and is afterwards deepened gradually to the extent of two inches. A spout is introduced about half an inch into the hole made by this auger, and projects from three to twelve inches from the tree. The spout is generally made of the shumach *, or elder †, which generally grow in the neighbourhood of the sugar trees. The tree is first tapped on the south side; when the discharge of its sap begins to lessen, an opening is made on its north side, from which an increased discharge takes place. The sap flows from four to six weeks, according to the temperature of the weather. Troughs large enough to contain three or four gallons, made of white pine, or white ash, or of dried water-ash, aspen, linden, poplar ‡, or common maple, are placed under the spout, to receive the sap, which is carried every day to a large receiver, made of either of the trees before mentioned."

The maple tree continues to yield a thin sap during the whole of the summer and part of the autumn; but what flows after April is not fit for the manufactory of sugar. It is not, however, without its use, as it affords a wholesome drink in harvest, which, according to the Baron La Hontan, is more grateful to the taste than the best lemonade or cherry water.

The sugar is made from the sap either by freezing, by spontaneous evaporation, or by boiling; but the last is the method most commonly practised of the three; and the Americans have found from experience, that the sap should never be kept longer than twenty-four hours, after it is collected, before

* *Rhus.* † *Sambucus canadensis.* ‡ *Liriodendron tulipifera.*

it is put over the fire. The sap, as has already been observed, flows into wooden troughs, from which it is carried and poured into store troughs, or large cisterns in the shape of a canoe, and from these into the kettle where it is to be boiled. During the process they add butter, hog's-lard or tallow, to prevent the kettle from boiling over; and lime, eggs, or new milk, are mixed with the juice in order to clarify it. A very small quantity, it seems, of these ingredients will suffice for the purpose, since a spoonful of slacked lime, the white of one egg, or a pint of new milk, will be sufficient to clarify fifteen gallons of sap. The sugar, after it has been sufficiently boiled, is conducted through the remaining processes nearly in the same manner as in the West Indies; therefore it will be unnecessary to repeat in this place what has been said under the description of the Sugar-cane: it may not, however, be uninteresting, to compare the maple sugar with that which is obtained from the West Indian cane, with respect to its quality, price, or the probable quantity that can be made of it in the United States. Dr. Rush has considered these heads with some attention, and the following is the result of his observations:

"1. The quality of this sugar is necessarily better than that which is made in the West Indies. It is prepared in a season when not a single insect exists to feed upon it, or to mix its excrements with it, and before a particle of dust or of the pollen of plants can float in the air. The same observation cannot be applied to the West India sugar. The insects and worms which prey upon it, and of course mix with it, compose a page in a nomenclature of natural history. I shall say nothing of the hands which are employed in making sugar in the West Indies, but that men who work for the exclusive benefit of others are not under the same obligations to keep their persons clean while they are employed in this work, that men, women, and children are, who work exclusively for the benefit of themselves, and who have been educated in the habits of cleanliness. The superior purity of the maple sugar is further evinced by its leaving a less sediment, when dissolved in water, than the West India sugar.

" It has been supposed that the maple sugar is inferior to the West India sugar in strength. The experiments which led to this opinion I suspect have been inaccurate, or have been made with maple sugar prepared in a slovenly manner. I have examined equal quantities by weight, of both the grained and loaf sugar, in hyson tea, and in coffee, made in every respect equal by the minutest circumstances that could affect the quality or taste of each of them, and could perceive no inferiority in the strength of the maple sugar. The liquors which decided this question were examined, at the same time, by Alexander Hamilton, esq. secretary of the treasury of the United States, Mr. Henry

Drinker, and several ladies, who all concurred in the above opinion.

" 2. Whoever considers that the gift of the sugar maple trees is from a benevolent Providence, that we have many millions of acres in our country covered with them, that the tree is improved by repeated tappings, and that the sugar is obtained by the frugal labour of a farmer's family; and at the same time considers the labour of cultivating the sugar-cane, the capitals sunk in sugar-works, the first cost of slaves and cattle, the expenses of provisions for both of them ; and in some instances the additional expense of conveying the sugar to a market, in all the West India islands, will not hesitate in believing that the maple sugar may be manufactured much cheaper, and sold at a less price, than that which is made in the West Indies.

" 3. The resources for making a sufficient quantity of this sugar, not only for the consumption of the United States, but for exportation, will appear from the following facts: There are in the states of New York and Pennsylvania, alone, at least ten millions of acres of land which produce the sugar maple tree, in the proportion of thirty trees to one acre. Now, supposing all the persons capable of labour in a family to consist of three, and each person to attend 150 trees, and each tree to yield five pounds of sugar in a season ; the product of the labour of 60,000 families would be 135,000,000 pounds of sugar; and, allowing the inhabitants of the United States to compose 600,000 families, each of which consumed 200 pounds of sugar in a year, the whole consumption would amount to 120,000,000 pounds, and would leave a balance of 15,000,000 pounds for exportation. Valuing the sugar at $\frac{6}{90}$ of a dollar per pound, the sum saved to the United States would be 8,000,000 dollars by home consumption, and the sum gained by exportation would be 1,000,000 dollars. The only part of this calculation that will appear improbable is, the number of families supposed to be employed in the manufactory of the sugar; but the difficulty of admitting this supposition will vanish, when we consider, that double that number of families are employed every year in making cyder, the trouble, risk, and expenses of which are all much greater than those of making maple sugar."

Besides the profit arising from the sugar, the maple tree affords an after sap, which makes an excellent vinegar; and as the juice that flows at this time is too weak to afford any sugar, the different processes do not interfere with each other. A pleasant summer beer may likewise be made from the molasses, and a spirit distilled from the sap.

The nourishment afforded by sugar is known to be very considerable; hence it is preferred by the Indians in their excursions from home. They are said to mix a certain quantity of maple sugar with an equal quantity of Indian corn, dried and powdered. This mixture is packed in little baskets, which are frequently wetted in travelling without injuring the sugar. Thus provided, the Indians make long journeys; and, when fatigued by travelling, will recruit their strength with a few spoonfuls of this nutritious food mixed in half a pint of spring water.

# SENSITIVE PLANT.

## POLYGAMIA MONOECIA.

### GENERIC CHARACTER.

Calyx of one small petal with four clefts.
Corolla funnel-shaped, half-five-cleft.
Pericarp a long pod, containing several seeds.

### SPECIFIC CHARACTER.

MIMOSA PUDICA. M. aculeata, foliis subdigitatis pinnatis, caule hispido. *Spec. Plant. Linn.* ed. tert. p. 1501.

Prickly Mimosa, with finger-shaped pinnated leaves and hairy stem.

Mimosa humilis frutescens & spinosa, siliquis conglobatis. *Plum. Spec.* 17. *Icon.* 203.

Mimosa foliis digitatis; foliolis pinnatis, caule aculeato hispidoque; foliis pinnato-palmatis, singulis numerose pinnatis. *Hort. Cliff.* 208.

SENSITIVE PLANT. *Comm. Hort.* 1. p. 57. pl. 29. *Dict. d'Hist. Nat.* ed. 1803. 1. p. 63. pl. 1. f. 2.

THIS well known exotic has long and justly been admired for exhibiting a very curious phænomenon. It has the singular property of contracting certain parts of its body whenever they are touched. By this motion, of which the cause still remains to be discovered, the plant appears to be sensible to the impression not only of bodies immediately applied to it, but likewise to the influence of the surrounding elements, &c. Thus sudden degrees of heat, or cold, the vapour of boiling water, the fumes arising from sulphur, the odour of volatile liquors; or, in short, any thing that deranges the nerves of animals, will also affect the sensitive plant.

There are other species of this genus that possess the same faculty in different degrees; the subject of our present consideration is the common sensitive plant, and was originally introduced into our gardens from Brasil, and other parts of South America. The stem is cylindrical, and of a green or purplish colour, with two spines at the base of each leaf, besides a few others scattered about the branches. The leaves are pinnatifid, supported on long footstalks, and each pinnule is furnished with fifteen or twenty pair of oblong, narrow, and shining leaflets. From the base of the leafstalks proceed the peduncles, each of which supports a bunch of very small white or flesh-coloured flowers. The seed-vessels are united in packets of twelve or fifteen each: they are edged with minute spines, and each husk contains three little seeds.

As soon as the evening approaches, the sensitive plant begins to lower its leaves, till at length they rest upon the stem: but it is not this property which is so remarkable; as, far from being confined to the mimosa, it is common to many plants, especially of the leguminous kind. This is not the case, however, with its moving faculty, which from its singularity has so long excited the astonishment of the naturalist.

Among those who have attended to its motions and the phænomena which result from them, may be ranked the learned Dr. Hook. Other naturalists, especially Dufay and Duhamel, have, since his time, studied the same plant with equal attention; and from their observations we learn that it is difficult to touch a leaf of a healthy mimosa, even in the most careful and delicate manner, without causing it to close. The great nerve which runs along the middle of the leaf, serves as a hinge for the sides to close upon, and they may be observed to do this with great exactness, the two sides being exactly opposed to each other. If the pressure is made with any degree of force, the opposite leaf of the same pair will be affected at the same time, and move in the same manner. Upon squeezing the leaf still harder, all the leaflets of the same side resent the affront, and close immediately: the effect may be even carried so far that the leaf-stalk will approach the branch from which it issues, and the whole plant collect itself into a bundle, and become reduced to a certain point.

When the leaves have even faded and turned yellow, or rather when the branches are in a dying state, the plant will retain its sensibility, and close its leaves upon being agitated. A fine rain will not disturb the mimosa in the least; but if it falls heavily, and is accompanied with wind, the plant immediately becomes affected.

The leaves which have been irritated and made to close, at length recover themselves and resume their former position. The time necessary to effect this purpose is unequal, since it depends on different circumstances, such as the health of the plant, the season of the year, the hour of the day; sometimes it is effected in twenty minutes, sometimes in less than ten. The order also in which this is managed, is subject to vary; sometimes it begins in the leaves on the sides of the leaflets, sometimes in the branches, and then the whole of the plant is generally included in the motion.

It is said in the *Histoire de l'Académie des Sciences*, for the year 1729, that in a dark place, and in a uniform temperature, the mimosa never fails to observe two periodical motions, that is, to shut up its leaves at night, and open them again in the morning. The following experiment, however, made by Dufay and Duhamel, does not appear to confirm this observation:—“ A sensitive plant being carried in the month of August into a dark cave, where the temperature of the air was more equal than in the place appropriated to the former experiment, the plant indeed closed its leaves; but it was, in all probability, occasioned by being shook in the carriage. It did not recover itself till about twenty-four hours afterwards, and from that time continued open during three days, though not quite so much so as when in a perfectly natural state.

The plant was then carried into the open air, where, after remaining a night, it was perfectly recovered, without having been at all weakened by its late usage, or having lost any of its former sensibility."

By this experiment, which is not the only one that was made, it is pretty clear that neither light nor darkness has any sensible effect upon the sensitive plant; it is not so passive, however, under the different degrees of temperature. In a place which has been greatly heated, and where the thermometer will suddenly rise several degrees, the mimosa will shut sooner than when in the open air:—" from having observed this to take place several times, we are led to suppose that the cause of its spontaneous motion is the great and sudden changes of temperature which so commonly take place in our climate: this opinion may be easily put to the proof; for if a plant of this species be raised under a bell-glass, exposed to the heat of the sun, it will close almost the moment it is uncovered, provided the external air is in a much cooler state."

Nevertheless, though heat and cold contribute greatly towards its alternate motion, yet the plant is certainly less sensible, or more sluggish in its movements, during the winter. In a good green house, indeed, it will continue to contract through the whole of this inclement season; but then its functions seem to be considerably impaired, and it moves with less vivacity.

After a branch has been separated from the shrub the leaves still retain their sensibility, and will shut on being touched, or from any of the causes which excited their action before. If the end of the branch is kept in water, the leaves will continue to act for a considerable time. It is of no consequence with what substance we touch the plant; but this is not exactly the case with respect to the part, since there is, in the articulations of the leaves, a little place, known by its white colour, which appears to be particularly irritable.

If the sensitive plant be plunged into water, the leaves from the influence of the cold will close; but afterwards they will recover themselves, and if touched in this state, will again shut themselves up as if they had been in the open air; but by no means so quickly. This experiment does not materially injure the plant; for in the course of a day or two it completely recovers, and appears as vigorous as if it had never been removed from its natural element.

Any violent application to this very curious plant immediately produces the most sensible effect: if the extremity of a leaf exposed to the rays of the sun, is burnt either with a lens or with a lighted taper, or is squeezed between a pair of hot pincers, it closes in an instant; and in the same moment, not only the leaflet which is opposite to it does the same, but all that are upon the same stalk; and this will take place more or less, according to the strength of the impression, so that when the injury has been very great, the plant will be violently agitated for some distance round the spot.

If a drop of aqua-fortis is placed upon a leaf so as to remain stationary, it does not affect the plant; but when it begins to spread, the irritation is communicated from one leaflet to another, till the whole of them on that part of the stalk are closed. The vapour of burning sulphur immediately deranges them, and the leaves will be affected, according as they are more or less exposed to the fumes. Although a branch of this extraordinary plant be divided through two thirds of its diameter, yet the leaves belonging to it retain the same degree of sensibility, and open and shut with the same freedom as before. This is the fact, though at the same time we must acknowledge it difficult to conceive how so great a wound can be made without producing any sensible alteration in the plant.

The vapour of boiling water affects the leaves in the same manner as if they were burnt, and those which are exposed to its influence are benumbed for several hours, and seldom recover themselves entirely during the remainder of the day.

Thus we have detailed the principal phænomena that occur in this very singular plant, upon which so many observations have been made. Many conjectures have been formed, and many theories raised, to account in a satisfactory manner for the spring which works this delicate machine; but as yet it has eluded the search of the naturalist, and the question will not probably be soon resolved. It has been supposed by some that the mimosa is endued with a power of perception which actuates all its motions; others think that its movements depend on a convulsive or spasmodic effort, while there are many, and those not the least rational, who consider all its actions as purely mechanical. To enter into discussions of this kind would lead us far beyond the limits of our undertaking; we shall therefore be satisfied to leave the matter as it stands, and only contemplate the plant, as one of those natural wonders which tend to lead us, by gentle and pleasing steps, to the knowledge of an all-powerful Creator.

# FIG TREE.

### POLYGAMIA TRIOECIA.

#### GENERIC CHARACTER.

Male. Calyx divided into three parts.
Corolla none.

Female. Calyx of five divisions.
Corolla none.
The male flowers are situated near the top of the fig, just under the eye; the females within the body of the fruit, where each produces a small flattish seed.

#### SPECIFIC CHARACTER.

Ficus carica. F. foliis palmatis. *Linn. Spec. Plant.* ed. tert. p. 1513.
Leaves hand-shaped.
Ficus communis. *Bauh. Pin.* 457.
Ficus. *Dod. Pempt.* 812.
Ficus humilis. *Bauh. Pin.* 457.

Common Fig. *Duhamel, Traité des Arbres,* 1. p. 235. pl. 99.

The fig is a striking instance of that contrivance which Nature occasionally employs for the continuation of her species. We were for a long time unacquainted with the manner in which these plants were propagated: in other kinds it is the flower which contains the embryo of the fruit; in this, on the contrary, it is the fruit which encloses and conceals the flower. The mode in which the fig trees are made to produce their fruit, is called *caprification*, and this we shall proceed to explain in its proper place.

Among the several species of this genus which have been enumerated by botanists, the common fig is by far the most useful, and is cultivated in many parts of Europe for the excellence of its fruit. The wild as well as the cultivated kind is supposed to have been originally brought from Asia, from whence they have been spread over the southern parts of Europe, and are now to be met with in Languedoc, in Provence, in Spain, in Italy, &c.; not to mention those of England, which are merely raised for the table, and not cultivated, like those abroad, for commercial purposes.

Where the climate is congenial to their nature, figs seem to thrive in almost any soil; but Duhamel observes, that they produce the most succulent fruit when growing among the rocks. They require a certain degree of heat: for although this gentleman saw figs of a monstrous size at Brest, yet they rarely became perfectly ripe for want of the necessary warmth. The trees are generally raised from slips or layers, which readily strike root; and the manner which is often practised to effect this is simple enough, though rather singular. When it is proposed to propagate the plant by layers, a branch of the tree is made to pass through a tin funnel, or a wicker basket, filled with earth, into which the branch will soon shoot several fibres; it should then be cut asunder below the basket, which should afterwards be placed in the earth. When it is desired to raise fig trees that will bear fruit the next year, the finest branches of an old tree are laid in the earth, and one of a moderate size is caused to pass through a box, after being stripped of its bark for about a finger's breadth between two knots. The part so stripped is then placed about four fingers' breadth above the bottom of the box, and covered with earth. In due time the branch will shoot out several roots from the wounded part, after which it is separated from the stem by cutting it off below the box.

Duhamel is of opinion that a good sort of fig, raised in a congenial soil, and perfectly ripe, is one of the best of our eatable fruits. In Languedoc, in Provence, in Spain, in Italy, and in the Levant, vast quantities of figs are dried in the sun, and form a considerable article of traffic. The inhabitants of the fig countries eat them in abundance, both fresh and in the dried state; they are indeed said to form a great part of the nourishment of the country people on the northern coasts of the Mediterranean, and in the isles of the Archipelago.

Several of the cultivated species, according to Duhamel, require only the ordinary attention paid to fruit-trees to make them ripen their fruit; but in the Archipelago, and in Malta, there are figs, both wild and domestic, that require a very singular mode of treatment to make them bring their fruit to perfection; the assistance we here allude to is named *caprification*, and is a phænomenon highly deserving our attention.

The most satisfactory account of this curious operation is to be found in Tournefort's Voyage to the Levant, which account has been strengthened by the observations made at Malta, by M. Godeheu, on the same subject. We are informed by M. Tournefort that only two kinds of figs are cultivated in the Archipelago, the domestic and the wild; from the former they gather that fruit which can only be brought to perfection by the assistance of the latter, or wild fig, which has been named *caprificus*, and in the country *ornos*. This tree bears successively, in the same year, three sorts of fruit, to which the natives of the Archipelago have given different names.

The first fruit, which they name *fornites*, are the autumnal figs; they appear in August, and fall in September and October. The second figs, called *cratitires*, are the winter figs, and remain on the trees from September till May; then come the third kind, or spring figs, known in the country by the name of *orni*.

None of these fruits ripen, but they have a sleek even skin, of a deep green colour, and contain in their dry and mealy inside several male and female flowers, placed upon distinct footstalks, the former above the latter. In the first figs, or fornites, are bred small worms which change to a species of cynips *, peculiar to these trees. In October and November, these insects of themselves make a puncture into the second fruit, after which the autumnal figs fall; but the winter fruit, or cratitires, remain, as we have observed, till May, and enclose the eggs deposited by the gnats when they pricked them. In May the third sort of fruit, called orni, begin to be produced by the wild fig trees. This is much bigger than the other two; and when it grows to a certain size, and its bud begins to open, it is pricked in that part by the cynips of the winter figs which are strong enough to go from one fruit to another to deposit their eggs. It sometimes happens that the insects of the cratitires are slow to come forth in certain parts, while the orni in those very parts are ready to receive them. In this case the husbandman is obliged to look for the cratitires in another part, and fix them at the ends of the branches of those fig trees whose orni are fit to be pricked by the insects. If they miss the opportunity, the orni fall, and the insects from the winter figs fly away. None but those who are well acquainted with the culture know the critical moment of doing this; and in order to know it, their eye is perpetually fixed on the bud of the fig; for that part not only indicates the time that the insects are to issue forth, but also when the fig is to be suc-

* Cynips psenes. *Linn. Syst. Nat. Gmel.*

cessfully pricked: if the bud is too close, the fly cannot deposit its eggs; if, on the contrary, it is too open, the fruit falls to the ground.

None of the wild figs are good to eat; their chief use is to assist in ripening the domestic kind, and the manner in which this is effected is as follows: During the months of June and July, the peasants take the orni at the time their insects are ready to break out, and carry them to the garden fig trees; if they miss the proper time, the orni fall, and the fruit of the domestic fig will in consequence prove barren, and fall also. The natives are so well acquainted with these precious moments, that, every morning, in making their inspection, they only transfer to their garden fig trees such orni as are well conditioned, otherwise they lose their crop. In this case, however, they have one remedy; which is to strew over the garden fig trees another plant in whose fruit there is also a species of insect, which in some measure answers the purpose. The countrymen so well understand how to manage their orni, that the flies which proceed from them ripen their domestic figs in the space of forty days.

The Greeks cannot be too much admired for the time and patience which they bestow to bring about this singular process. They may be seen, during more than two months of the year, busily employed in transporting the flies from one tree to another: it must be confessed, however, that they are well rewarded for their trouble, since a tree which, left to itself, will scarcely yield twenty-five pounds of ripe figs, may, by the assistance of these insects, be made to produce nearly ten times that quantity.

It has been observed by M. Godeheu, that caprification, though the means of producing a large crop, is injurious to the trees, and prevents their yielding well on the following year.

The heat of the sun is not sufficient to dry the figs produced by caprification. They must be placed in the oven, which gives them a disagreeable taste; but is, nevertheless, very necessary to kill the cynips, which might otherwise produce their larvæ and destroy the figs.

Caprification, as described by antient authors, is precisely the same operation as is at present performed in the Archipelago. All agree in declaring that the wild fig tree, *caprificus*, never ripened its fruit, but was absolutely necessary for ripening that of the garden or domestic kind, over which the peasants suspended its branches. Linnæus explains this operation, by supposing that the insects brought the farina from the wild fig which contained male flowers only, to the domestic fig, which contained the female ones: but Hasselquist, from what he saw in Palestine, seemed to doubt of this mode of fructification, and M. Bernard has opposed the hypothesis decidedly. He could never find the insect in the cultivated fig; and, in reality, it appeared to leave the wild fig, after the stamina were mature and their pollen dissipated; besides, he adds, what they may have brought on their wings must be rubbed away in the little aperture which they would form for themselves. At Malta, where there are seven or eight varieties of the domestic fig, this operation is only performed on those which ripen latest; the former are of a proper size, fine flavour, and in great abundance without it; so that he thinks the caprification only hastens the ripening. The probability of this conjecture is strengthened by knowing that the figs in Provence ripen much sooner, for having their buds pricked with a straw dipped in olive oil.

There are other kinds of figs growing naturally in the warmer parts of Asia, Africa, and America; the most part of which produce fruit which are not fit to eat, though many have their uses, and are highly curious in other respects. The most interesting of these are,

The sycamore fig, *Ficus sycamorus* Linn., which grows to an amazing size, and to a great height. The branches spread so prodigiously, that, according to Forskal, they sometimes overshadow a circular space of ground equal to forty feet in diameter. The fruit, which grows close to the stem and branches, is pierced in a remarkable manner by an insect. A little below the scales, on the side of the flower-cup, there appears a spot before the fruit is ripe; the fruit in this place is affected with a gangrene which extends on every side, and frequently occupies a finger's breadth. It withers; the place affected becomes black; the fleshy substance in the middle of the calyx for the breadth of a quill is corroded; and the male blossoms which are nearest to

BANYAN.

*Designed by W. Daniell.*

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the base side appear naked, opening a way for the insect, which makes several furrows in the inside of the fruit, but never touches the stigmata, though it frequently eats the germen. The wounded or gangrenous part is at first covered or shut up by the blossoms; but the hole is by degrees opened and enlarged of various sizes in the different fruits; the margins and sides being always gangrenous, black, hard, and turned inwardly. The same gangrenous appearance is also found near the scales, after the insect has made a hole in that place. The tree is very common in the plains and fields of Lower Egypt. It buds in the latter end of March, and the fruit ripens in the beginning of June. It is wounded or cut by the inhabitants at the time it buds; for without this precaution it is said not to bear fruit. The figs are shaped like the common sort; they rarely, however, arrive at maturity; when they do they are eaten by the people, and have a sweet taste, but are said to be digested with difficulty.

The Banian Tree (*Ficus religiosa* Linn.) is one of the most striking of Nature's productions. It is a very singular tree, growing in the stony and sandy districts of the East Indies, where it reaches to a vast height, and spreads its branches in every direction. The banian tree possesses an advantage over the rest of the vegetable creation; it is enabled to increase without the assistance of seed, by sending forth young fibres from time to time, which, finding their way to the earth, take root, and thus exempt the parent tree from decay. Every branch from the main body throws out its own roots; at first, in small tender fibres, several yards from the ground: these continually grow thicker till they reach the surface; and there striking in, they increase to large trunks, and become like the original tree. Thus is the tree continually increasing; for those newly produced, in time send forth their fibres, and multiply in the same manner.

It is not at all surprising that a production of such a singular nature as the present, should become the object of superstitious veneration among the Hindoos; they look upon it as an emblem of the Deity, and almost pay it divine honours. Near these trees the most esteemed pagodas are generally erected; under their shade the bramins spend their lives in religious solitude; and the natives of all casts and tribes are fond of recreating in the cool recesses, beautiful walks, and lovely vistas of this umbrageous canopy, impervious to the hottest beams of a tropical sun. Tavernier mentions one of these trees as growing in his time at Surat, in the hollow trunk of which was the figure of a monster, representing the face of a deformed female, who, they tell you, was the first woman, and call her *Mamaniva.* "To this tree," says Tavernier, "great numbers of idolaters every day resort; near to which there is some bramin or other always appointed to be ready to say prayers, and receive the alms of rice, millet, and other grains, which the charitable bestow upon them. The bramin marks the forehead of all, both men and women, that come to pray in the pagod, with a kind of vermilion, wherewith he also besmears the idol; for, being thus marked, they believe the evil spirit cannot hurt them, as being then under the protection of their god."

A remarkable large tree of this kind is said to grow on an island in the river Nerbedda, ten miles from the city of Baroche, in the province of Guzerat. It is distinguished by the name of *Cubbeer Burr*, which was given it in honour of a famous saint. It was once much larger than at present; but high floods have carried away the banks of the island where it grows, and with them such parts of the tree as had thus far extended their roots; yet what remains is about two thousand feet in circumference, measured round the principal stems; the overhanging branches not yet struck down, cover a much larger space. The chief trunks of this single tree (which in size greatly exceed our English elms and oaks) amount to three hundred and fifty; the smaller stems are more than three thousand; and every one of these is casting out new branches, and hanging roots, in time to form trunks, and become the parents of a future progeny. Cubbeer Burr is famed throughout Hindostan for its great extent and beautiful appearance. The Indian armies generally encamp around it; and, at stated seasons, solemn jatarras, or Hindoo festivals, are held there, to which thousands of votaries repair from various parts of the Mogul empire. It is said that seven thousand persons find ample room to repose under its shade. The English gentlemen, on their hunting and shooting parties, used to form extensive encampments, and spend weeks together under this delightful pavilion, which is generally filled with green wood pigeons, doves, peacocks, and singing birds: large families of monkeys live among its branches, and numbers of enormous bats are seen flitting beneath its ample shade. This tree, in the proper season, is covered with small figs of a scarlet colour, which serve to nourish the numerous inhabitants that are found within its shelter.

## BUTTER TREE.

This singular tree is, as yet, but very imperfectly known to botanists; all the information we have hitherto obtained respecting it, being from the observations of Mungo Park, who has figured a branch in his Travels into the Interior of Africa. It appears that the tree is of a moderate size, with long, alternate leaves. It produces a fruit about the size of a walnut, and of an aromatic smell. Within the fruit is a stone containing a kernel the size of an acorn.

This slight sketch of its botanical character is all we know at present, except the account Park has given us relating to its singular produce, which certainly ranks it among the first of African vegetables in point of utility.

When Park had reached a certain district, he found the people busily employed in collecting the fruit of the shea trees, from which they prepare the vegetable butter. These trees grow in great abundance in the part of Bambara through which he was then travelling. It seems that they are not cultivated by the natives, but are found growing naturally in the woods; and that in clearing wood land for cultivation, every tree is cut down but the shea. "The tree itself," says Park, "very much resembles the American oak; and the fruit (from the kernel of which, being first dried in the sun, the butter is prepared by boiling the kernel in water,) has somewhat the appearance of a Spanish olive. The kernel is enveloped in a sweet pulp, under a thin green rind; and the butter produced from it, besides the advantage of its keeping the whole year without salt, is whiter, firmer, and, to my palate, of a richer flavour than the best butter I ever tasted made from cows' milk. The growth and preparation of this commodity seem to be among the first objects of African industry in this and the neighbouring states, and it constitutes the main article of their inland commerce.

# POISON TREE.

It has been long known that particular trees are of a poisonous quality, and occasion thè death of such animals as incautiously feed upon them; but the subject of our present consideration greatly exceeds every other plant in its deleterious effects, and is said even to occasion a barrenness in the ground for a considerable distance round the spot where it grows. We are at a loss to assign its proper place in the vegetable system, as neither its class nor order is known: indeed the many apparently exaggerated accounts of its wonderful properties, would have made us reject it entirely, had it not been for the authority of M. Foersch, a Dutch naturalist, who has given a very circumstantial account of this singular tree. What this gentleman has said upon the subject has been translated from the original Dutch, and in that state we shall insert it; leaving the reader to make his own comments on the wonderful effects of the plant.

M. Foersch tells us that this destructive tree is called in the Malayan language *Bohun-Upas*, and has been described by naturalists; but their accounts have been so tinctured with the marvellous, that the whole narration has been supposed to be an ingenious fiction by the generality of readers. Nor is this in the least degree surprising, when the circumstances which we shall faithfully relate in this description are considered.

"I must acknowledge," says M. Foersch, "that I long doubted the existence of this tree, until a stricter inquiry convinced me of my error: I shall now only relate simple unadorned facts, of which I have been an eye-witness. My readers may depend upon the fidelity of this account. In the year 1774, I was stationed at Batavia, as a surgeon in the service of the East India Company. During my residence there I received several different accounts of the Bohun-Upas, and the violent effects of its poison. They all then seemed incredible to me, but raised my curiosity in so high a degree, that I resolved to investigate this subject thoroughly, and to trust only to my own observations. In consequence of this resolution I applied to the governor-general, Mr. Petrus Albertus van der Parra, for a pass to travel through the country: my request was granted; and, having procured every information, I set out on my expedition. I had procured a recommendation from an old Malayan priest to another priest, who lives on the nearest inhabitable spot to the tree, which is about fifteen or sixteen miles distant. The latter proved of great service to me in my undertaking, as that priest is appointed by the emperor to reside there, in order to prepare for eternity the souls of those who, for different crimes, are sentenced to approach the tree, and to procure the poison.

"The Bohun-Upas is situated in the island of Java, about twenty-seven leagues from Batavia, fourteen from Soura Charta, the seat of the emperor, and between eighteen and twenty leagues from Tinkjoe, the present residence of the sultan of Java. It is surrounded on all sides by a circle of high hills and mountains; and the country round it, to the distance of ten or twelve miles from the tree, is entirely barren. Not a tree nor a shrub, nor even the least plant or grass is to be seen. I have made the tour all around this dangerous spot, at about eighteen miles distant from the centre, and I found the aspect of the country on all sides equally dreary. The easiest ascent of the hills is from that part where the old ecclesiastic dwells. From his house the criminals are sent for the poison, into which the points of all warlike instruments are dipped. It is of high value, and produces a considerable revenue to the emperor.

"The poison which is procured from this tree, is a gum that issues out between the bark and the tree itself, like the camphor. Malefactors, who for their crimes are sentenced to die, are the only persons who fetch the poison; and this is the only chance they have of saving their lives. After sentence is pronounced upon them by the judge, they are asked in court, whether they will die by the hands of the executioner, or whether they will go to the Uphas tree for a box of poison? They commonly prefer the latter proposal, as there is not only some chance of preserving their lives, but also a certainty, in case of their safe return, that a provision will be made for them in future by the emperor. They are also permitted to ask a favour from the emperor, which is generally of a trifling nature, and commonly granted. They are then provided with a silver or tortoise-shell box, in which they are to put the poisonous gum, and are properly instructed how to proceed while they are upon their dangerous expedition. Among other particulars, they are always told to attend to the direction of the winds; as they are to go towards the tree before the wind, so that the effluvia from the tree is always blown from them. They are told likewise, to travel with the utmost dispatch, as that is the only method of insuring a safe return. They are afterwards sent to the house of the old priest, to which place they are commonly attended by their friends and relations. Here they generally remain some days, in expectation of a favourable breeze. During that time the ecclesiastic prepares them for their future fate by prayers and admonitions.

"When the hour of their departure arrives, the priest puts them on a long leather cap, with two glasses before their eyes, which come down as far as their breast; and also provides them with a pair of leather gloves. They are then conducted by the priest, and their friends and relations, about two miles on their journey. Here the priest repeats his instructions, and tells them where they are to look for the tree. He shows them a hill, which they are told to ascend, and that on the other side they will find a rivulet, which they are to follow, and which will conduct them directly to the upas. They now take leave of each other, and, amidst prayers for their success, the delinquents hasten away.

"The worthy old ecclesiastic has assured me, that during his residence there, for upwards of thirty years, he had dismissed above seven hundred criminals in the manner which I have described; and that scarcely two out of twenty have returned. He showed me a catalogue of all the unhappy sufferers, with the date of their departure from his house annexed; and a list of the offences for which they had been condemned: to which was added a list of those who had returned in safety. I afterwards saw another list of these culprits, at the jail-keeper's at Soura Charta, and found that they perfectly corresponded with each other, and with the different informations which I afterwards obtained.

"I was present at some of these melancholy ceremonies, and desired different delinquents to bring with them some pieces of the wood, or a small branch, or some leaves of this wonderful tree. I have also given them silk cords, desiring them to measure its thickness. I never could procure more than two dry leaves that were picked up by one of them on his return; and all I could learn from him, concerning the tree itself, was, that it stood on the border of a rivulet, as described by the old priest; that it was of a middling size; that five or six young trees of the same kind stood close by it;

but that no other shrub or plant could be seen near it; and that the ground was of a brownish sand, full of stones, almost impracticable for travelling, and covered with dead bodies. After many conversations with the old Malayan priest, I questioned him about the first discovery, and asked his opinion of this dangerous tree; upon which he gave me the following answer:

" 'We are told in our new Alcoran, that, above a hundred years ago, the country round the tree was inhabited by a people strongly addicted to the sins of Sodom and Gomorrah: when the great prophet Mahomet determined not to suffer them to lead such detestable lives any longer, he applied to God to punish them; upon which God caused this tree to grow out of the earth, and rendered the country for ever uninhabitable.'

" Such was the Malayan opinion. I shall not attempt a comment; but must observe, that all the Malayans consider this tree as an holy instrument of the great prophet to punish the sins of mankind; and, therefore, to die of the poison of the upas is generally considered among them as an honourable death. For this reason, I also observed that the delinquents who were going to the tree were generally dressed in their best apparel. This, however, is certain, though it may appear incredible, that from fifteen to eighteen miles round this tree, not only no human creature can exist, but that, in that space of ground, no living animal of any kind has ever been discovered. I have also been assured by several persons of veracity, that there are no fish in the waters, nor has any rat, mouse, or any other vermin, been seen there; and when any birds fly so near this tree that the effluvia reaches them, they fall a sacrifice to the effects of the poison. This circumstance has been ascertained by different delinquents, who, in their return, have seen the birds drop down, and have picked them up dead, and brought them to the old ecclesiastic. I will here mention an instance which proves the fact beyond all doubt, and which happened during my stay at Java.

"In 1775 a rebellion broke out among the subjects of the massay, a sovereign prince, whose dignity is nearly equal to that of the emperor. They refused to pay a duty imposed upon them by their sovereign, whom they openly opposed. The massay sent a body of a thousand troops to disperse the rebels, and to drive them, with their families, out of his dominions. Thus four hundred families, consisting of above sixteen hundred souls, were obliged to leave their native country. Neither the emperor nor the sultan would give them protection, not only because they were rebels, but also through fear of displeasing their neighbour, the massay. In this distressful situation they had no other resource than to repair to the uncultivated parts round the upas, and requested permission of the emperor to settle there. Their request was granted, on condition of their fixing their abode not more than twelve or fourteen miles from the tree, in order not to deprive the inhabitants, already settled at a greater distance, of their lands. With this they were obliged to comply; but the consequence was, that in less than two months their number was reduced to about three hundred. The chiefs of those who remained returned to the massay, informed him of their losses, and entreated his pardon; which induced him to receive them again as subjects, thinking them sufficiently punished for their misconduct. I have seen and conversed with several of those who survived, soon after their return. They all had the appearance of persons tainted with an infectious disorder; they looked pale and weak; and from the account which they gave of the loss of their comrades, and of the symptoms and circumstances which attended their dissolution, such as convulsions, and other signs of violent death, I was fully convinced that they fell victims to the poison.

"This violent effect of the poison, at so great a distance from the tree, certainly appears surprising, and almost incredible; and especially when we consider that it is possible for delinquents who approach the tree to return alive. My wonder, however, in a great measure ceased, after I had made the following observations:

"I have said before, that malefactors are instructed to go to the tree with the wind, and to return against the wind. When the wind continues to blow from the same quarter while the delinquent travels thirty or six-and-thirty miles, if he be of a good constitution he certainly survives. But what proves the most destructive is, that there is no dependence on the wind in that part of the world for any length of time. There are no regular land winds; and the sea wind is not perceived there at all, the situation of the tree being at too great a distance, and surrounded by high mountains and uncultivated forests. Besides, the wind there never blows a fresh regular gale, but is commonly merely a current of light, soft breezes, which pass through the different openings of the adjoining mountains. It is also frequently difficult to determine from what part of the globe the wind really comes, as it is divided by various obstructions in its passage, which easily change the direction of the wind, and often totally destroy its effects.

"I therefore impute the distant effects of the poison, in a great measure, to the constant gentle winds in those parts, which have not power enough to disperse the poisonous particles. If high winds were more frequent and durable there, they would certainly weaken very much, and even destroy, the obnoxious effluvia of the poison; but without them the air remains infected and pregnant with these poisonous vapours.

"I am the more convinced of this, as the worthy ecclesiastic assured me, that a dead calm is always attended with the greatest danger, as there is a continual perspiration issuing from the tree, which is seen to rise and spread in the air, like the putrid steam of a marshy cavern.

"In the year 1776, in the month of February, I was present at the execution of thirteen of the emperor's concubines, at Soura Charta, who were convicted of infidelity to the emperor's bed. It was in the forenoon, about eleven o'clock, when the fair criminals were led into an open space within the walls of the emperor's palace. There the judge passed sentence upon them, by which they are doomed to suffer death by a lancet poisoned with upas. After this the Alcoran was presented to them, and they were, according to the law of their great prophet Mahomet, to acknowledge and to affirm by oath, that the charges brought against them, together with the sentence and their punishment, were fair and equitable. This they did, by laying their right hand upon the Alcoran, their left hands upon their breast, and their eyes lifted towards heaven;—the judge then held the Alcoran to their lips, and they kissed it.

"These ceremonies over, the executioner proceeded on his business in the following manner: Thirteen posts, each about five feet high, had been previously erected. To these the delinquents were fastened, and their breasts stripped naked. In this situation they remained a short time in continual prayers, attended by several priests, until a signal was given by the judge to the executioners; on which the latter produced an instrument much like the spring lancet used by farriers for bleeding horses. With this instrument, it being poisoned with the gum of the upas, the unhappy wretches were lanced in the middle of their breasts, and the operation was performed upon them all in less than two minutes.

"My astonishment was raised to the highest degree, when I beheld the sudden effects of that poison; for in about five minutes after they were lanced they were taken with a tremor attended with a subsultus tendinum, after which they died in the greatest agonies, crying out to God and Mahomet for mercy. In sixteen minutes by my watch, which I held in my hand, all the criminals were no more. Some hours after their death, I observed their bodies full of livid spots, much like those of petechiæ, their faces swelled, their colour changed to a kind of blue, their eyes looked yellow, &c. &c.

"About a fortnight after this I had an opportunity of seeing such another execution at Samarang. Seven Malayans were executed there with the same instrument, and in the same manner; and I found the operation in the poison, and the spots in their bodies, exactly the same.

"These circumstances made me desirous to try an experiment with some animals, in order to be convinced of the real effects of this poison; and as I had then two young puppies, I thought them the fittest objects for my purpose. I accordingly procured with great difficulty some grains of upas. I dissolved half a grain of that gum in a small quantity of arrack, and dipped a lancet into it. With this poisoned instrument I made an incision in the lower muscular part of the belly in one of the puppies. Three minutes after it received the wound the animal began to cry out most piteously, and ran as fast as possible from one corner of the room to the other. So it continued during six minutes; when all its strength being exhausted, it fell upon the ground, was taken with convulsions, and died in the eleventh minute. I repeated this experiment with two other puppies, with a cat, and a fowl, and found the operation of the poison in all of them the same: none of these animals survived above thirteen minutes.

"I thought it necessary to try also the effect of the poison given inwardly, which I did in the following manner: I dissolved a quarter of a grain of the gum in half an ounce of arrack, and made a dog of seven months old drink it. In seven minutes a retching ensued, and I observed at the same time, that the animal was delirious; as it ran up and down the room, fell on the ground, and tumbled about; then it rose again, cried out very loud, and about half an hour after was seized with convulsions, and died. I opened the body, and found the stomach very much inflamed, as the intestines were in some parts, but not so much as the stomach. There was a small quantity of coagulated blood in the stomach; but I could discover no orifice from which it could have issued; and therefore supposed it to have been squeezed out of the lungs, by the animal's straining while it was vomiting.

"From these experiments I have been convinced that the gum of the upas is the most dangerous and most violent of all vegetable poisons; and I am apt to believe that it greatly contributes to the unhealthiness of that island. Nor is this the only evil attending it: hundreds of the natives of Java, as well as Europeans, are yearly destroyed and treacherously murdered by that poison, either internally or externally. Every man of quality or fashion has his dagger or other arms poisoned with it; and in times of war, the Malayans poison the springs and other waters with it: by this treacherous practice the Dutch suffered greatly during the last war, as it occasioned the loss of half their army. For this reason they have ever since kept fish in the springs of which they drink the water, and sentinels are placed near them, who inspect the waters every hour, to see whether the fish are alive. If they march with an army or body of troops into an enemy's country, they always carry live fish with them, which they throw into the water some hours before they venture to drink it; by which means they have been able to prevent their total destruction. This account, I flatter myself, will satisfy the curiosity of my readers; and the few facts which I have related will be considered as a certain proof of the existence of this pernicious tree, and its penetrating effects.

"If it be asked why we have not yet any more satisfactory accounts of this tree, I can only answer, that the object of most travellers in that part of the world consists more in commercial pursuits than in the study of natural history and the advancement of sciences. Besides, Java is so universally reputed an unhealthy island, that rich travellers seldom make any long stay in it; and others want money, and are generally too ignorant of the language to travel in order to make inquiries. In future those who visit this island will now probably be induced to make it an object of their researches, and will furnish us with a fuller description of the tree."

Doctor Aejmelæus, who has likewise given some account of the poison tree in an Inaugural Dissertation published at Upsal, nearly agrees with M. Foersch; and says, that the tree is always solitary, the soil around it being barren, and, as it were, burnt up. It appears from his account that the juice is collected with the greatest caution, the person having his head, hands, and feet carefully covered with linen, that his whole body may be protected from the vapour as well as from the droppings of the tree. No one can approach so near as to gather the juice: hence they apply bamboos, pointed like a spear, which they thrust obliquely with great force into the trunk; the juice oozing out gradually fills the upper joint; and the nearer the root the wound is made, the more virulent the poison is supposed to be. Sometimes upwards of twenty reeds are left fixed in the tree for three or four days, that the juice may collect and harden in the cavities; the upper joint of the reed is then cut off from the remaining part, the concreted juice is formed into globules or sticks, and is kept in hollow reeds, carefully closed, and wrapped in tenfold linen. It is taken out every week to prevent it spoiling by becoming mouldy. The dried juice is of a dark brown colour, and liquefies by heat, like other resins. Its deleterious quality appears to be of a volatile nature, since it loses much of its power after being kept for a twelvemonth, and in the course of a few years becomes quite ineffectual.

# MINERALS.

UNDER this head are classed all those materials which form the basis of our globe, and are hidden within the bowels of the earth. We have hitherto considered only those objects which present themselves to our notice on the surface, and which, like us, depend for their existence on a proper supply of air: but we are now to leave the animated part of the creation, and descend to the interior of the globe, in order to investigate some of those curiosities which nothing but persevering industry could ever have brought to light.

The different parts of the mineral kingdom have been arranged under four heads; viz. *earths* and *stones*, *salts*, *combustible matters*, and *metals*. These various substances are met with in different states; sometimes they appear under the form of rude masses, of no determinate shape, sometimes in beds composed of layers running either in a horizontal or oblique direction; and this last disposition by beds is observed to be by far the most frequent.

Both the masses and beds of minerals exhibit varieties in their formation: some appear to have been composed of crystals mixed together in a confused manner, and united without any apparent attention to figure; such are the stones generally known by the name of granite, porphyry, statuary marble, &c. We observe that these stones are always situated beneath every other, and that they never enclose any remains either of the animal or vegetable kingdom.

Many layers are of a more homogeneous texture, and of a finer grain: they rather appear as if deposited like a sediment, than formed by any attention to regularity in their structure. These beds, or layers, are always placed either mediately or immediately above the others, and frequently contain the remains of organized substances: among them may be noticed slate, lime-stone, plaster, and most of the coloured marbles.

A third kind remains to be mentioned, which is supposed to derive its origin from the wreck of the first and second. This is found in the shape either of sand or pebbles; and although it does not appear to have any determinate relative place, it is nevertheless commonly found upon the surface of the two former.

To these three kinds of earth may yet be added a fourth, which, in its nature, and certainly in its origin, is very different from the three preceding. This is daily formed in many parts of the world; and being ejected from the bowels of burning mountains, has justly obtained the name of volcanic earth.

The first order we have noticed, such as the granite, porphyry, statuary marble, &c. from their being situated below the others, are supposed to have been formed before them, and therefore take the name of *primitive earths.* The layers above these are the *secondary earths :* after them follow the third series, and then the volcanic earths. These four kinds, either in a separate or united state, give figure, and various degrees of solidity, to the different mountains. The mountains which are formed of primitive layers are generally pointed. Those which partake of a volcanic origin are almost conical, whilst the mountains composed of beds of the second or third kind are either flat on their summits, or round on all sides.

Layers composed of the two first kinds of earth are often interrupted by slits or cracks, some of which are empty, while others are filled with stony or metallic substances, differing in their nature from the component parts of the beds through which they pass. These cracks by the miners are called *veins,* and are found to run in several directions, and with different degrees of inclination.

Buffon remarks, that in plains, the strata, or beds of mineral substances, are exactly horizontal. " It is in mountains only," says this naturalist, " that they are inclined to the horizon; because they have originally been formed by sediments deposited upon an inclined base.

"The beds of calcareous matters are not only horizontal in the plains, but likewise in all mountains which have not been disturbed by earthquakes or other accidental causes: and when the strata are inclined, the whole mountain is likewise inclined, and has been forced into that position by a subterraneous explosion, or by the sinking of a part of the earth, which had served it as a basis. We may therefore conclude, in general, that all strata formed by the sediments of water are horizontal, like the water itself, except those which have been formed on an inclined base, as is the case with the most part of coal-mines."

If these judicious remarks by the Count de Buffon could possibly require confirmation, they would receive it from observing the disposition of the strata of flint described by Sir H. Englefield in the sixth volume of the Linnæan Transactions.

In a chalk-pit in the Isle of Wight, close to the village of Carisbrook, there are several layers of flint from six to nine inches deep, separated from each other by intermediate strata of chalk, from two to nine feet in thickness. The flints are formed in the usual manner and of different sizes; but what constitutes the singularity is, that instead of lying in a horizontal direction, as we find them in other pits, they are all inclined to the horizon in an angle of at least sixty-seven degrees. On examining the pit with attention, Sir Henry was astonished to find that every flint, though lying in its place, and retaining perfectly its original shape, was more or less burst and shattered; some few were only split into large pieces, but the greater part were broken into small fragments, and some absolutely reduced to impalpable powder.

Sir Henry observes, that about two hundred yards below this pit, and near to Carisbrook village, the road is in part cut through the chalk, and the beds of flint exposed by that means, exhibit the same appearances as those in the pit above.

*Salts* exist in the earth in different states and in different forms; they are naturally without colour, and are more disposed to crystallize than other minerals. Under this head we find the vegetable, mineral, and volatile alkalis, with their combinations, forming saltpetre, sal-gem, &c.

The *inflammable substances* include all the bituminous minerals, such as the different kinds of coal, naphtha, petroleum, amber, &c.

But of all the mineral bodies, the metals which compose the last class are of the most importance to mankind. These are found in the bowels of the earth, often at a very considerable depth, from whence they are raised at great expense, and sometimes at the hazard of the workmen's lives. They are either disposed in great masses, or formed in veins, or layers, sometimes parallel to the beds of earthy materials in the mountains which enclose them; at other times cutting those beds in various directions, and almost always under a considerable angle.

"Metallic veins," says M. Eller, "are found only in elevated places in a long chain of mountains. This chain of mountains is always supported by a basis of hard rock. As long as this rock preserves its continuity, there is no chance of discovering metallic veins: but when we meet with crevices or fissures, we then entertain hopes of finding metal. Mineralogists have remarked that, in Germany, the most favourable situation is when the mountains rise gradually, stretch towards the south-east, and, after attaining their greatest elevation, descend gently towards the north-west.

"It is generally in a rugged rock," continues M. Eller, "the extent of which is often unlimited, but split into fissures, that metals are found sometimes pure, but generally in the state of ores. These fissures are commonly encrusted with a white shining substance, called *quartz* by the miners: this is generally accompanied with a substance not unlike it in appearance, but softer, called *spar*. These two coverings serve as a sheath for the vein. The more perpendicular the vein, the more is to be expected from it. Whenever the miners find a perpendicular vein, they say that it will be very productive.

"In proportion as the miners descend the fissures which furnish the metal, the air is always warmer; and the exhalations are sometimes so abundant, and so noxious, that, in order to avoid suffocation, the miners are obliged to fly to the pits or galleries, otherwise they would be instantly destroyed by the arsenical and sulphureous particles. Sulphur and arsenic are commonly found in the four imperfect, and in all the semimetals, and it is from these they receive their metallic form."

It is not the noxious vapours alone that the miners have to contend with, as they equally run the hazard of having a portion of the mine fall upon them and burying them in the ruins. This accident of course is more likely to occur in some situations than in others, and especially in mines where the looking-glass lead ore, or, as the miners call it, *slickensides,* abounds. The curious account of this mineral which Mr. Whitehurst, in his Observations on the Strata of Derbyshire, has given us, will point out the necessity of mining with caution in its neighbourhood.

"To what has been said of earthquakes," says Mr. Whitehurst, "I shall here add an account of a subterraneous explosion, which happens from a very obscure cause, in a sort of fossil called the *slickensides.* This stone has the appearance of black marble, and breaks when the explosion happens, with a polished surface not truly plane, but lying in waves. It is found in fissures of lime-stone in Haycliff and Ladywash mines at Eyam, and in Oden, at Castleton in Derbyshire. It is divided into two equal parts or slabs, by a line parallel to the sides of the fissure, and these slabs are joined by two polished faces, which seem to be in perfect contact without any cohesion. The surfaces are coloured with lead ore, but as thin as a covering from a black lead pencil. If a sharp-pointed tool, which the workmen call a pick, is drawn over the vein with some force, the minerals begin to crackle, like sulphur excited to electricity; in a few minutes after which they explode with violence, and fly out as if they had been blasted with gunpowder, insomuch that the weight of forty tons have been blown out together. These dangerous effects deterred the workmen from proceeding for several years; but at length it occurred to them, that this power might be used for the carrying on of their work with better advantage than by the common method of blasting with gunpowder. Accordingly a workman makes a scratch with his pick upon the joint of the slickensides, and runs away as fast as he can, to escape the explosion, which perhaps loosens as much of the rock as ten men would have brought away in three months by the ordinary methods. In the mines where this phænomenon occurs, the workmen were much alarmed on the first of November, 1755, about ten o'clock in the morning, the time of the earthquake so fatal at Lisbon. The rocks which surrounded them were so much disturbed, that soil, &c. fell from their joints or fissures, and they heard violent explosions as of cannon, for fear of which they fled to the surface; and, when all was quiet, were surprised to find that nothing material had happened under ground. It is probable that the shock of the earthquake had disturbed some of the slickenside mineral far under ground, and occasioned it to part and explode."

The presence of minerals in the earth is said to be indicated by several circumstances, though we believe none of them are to be much depended on. Among others may be mentioned the rolling stones found in the torrents; veins without metal, but composed of stones coloured by metallic oxides; waters holding in solution metallic salts; but above all, a just knowledge of the general constitution of the earth. This knowledge is certainly of considerable importance to the finding of metal in a district where it is supposed to exist, as it runs more readily through some strata than others.

In Derbyshire, which abounds in lead mines, the strata of earths and stones where the mineral is found are arranged in the following order:

1. A layer of sandstone of a considerble thickness, but subject to vary.

2. A bed of friable slate of 4 or 500 feet in thickness.

3. A bed of calcareous earth filled with shells: it is of a black colour, and from 100 to 150 feet thick.

4. A bed of toadstone, which varies from 40 to 100 feet in thickness.

5. A second calcareous layer full of marine productions, and about 100 feet thick.

6. A second layer of toadstone of 130 feet in thickness.

7. A third calcareous bed like the second, but double the thickness.

8. A third layer of toadstone, like the two others, 66 feet in thickness.

9. A fourth bed of calcareous matter, which has been penetrated 200 feet without reaching the bottom.

The veins which run in these different beds pursue a very regular course, and are from three to twenty feet thick. They run either in a perpendicular, or oblique direction; a very few are horizontal. It is remarked that the nature of the veins change according to the beds through which they pass, and that they disappear entirely in the toadstone. The veins in the beds of sandstone and slate are without metal: in the four calcareous layers, on the contrary, they are always very rich, but the mineral constantly disappears when cut off by the beds of toadstone; though, notwithstanding this interruption, it appears again and continues its course in the calcareous layers.

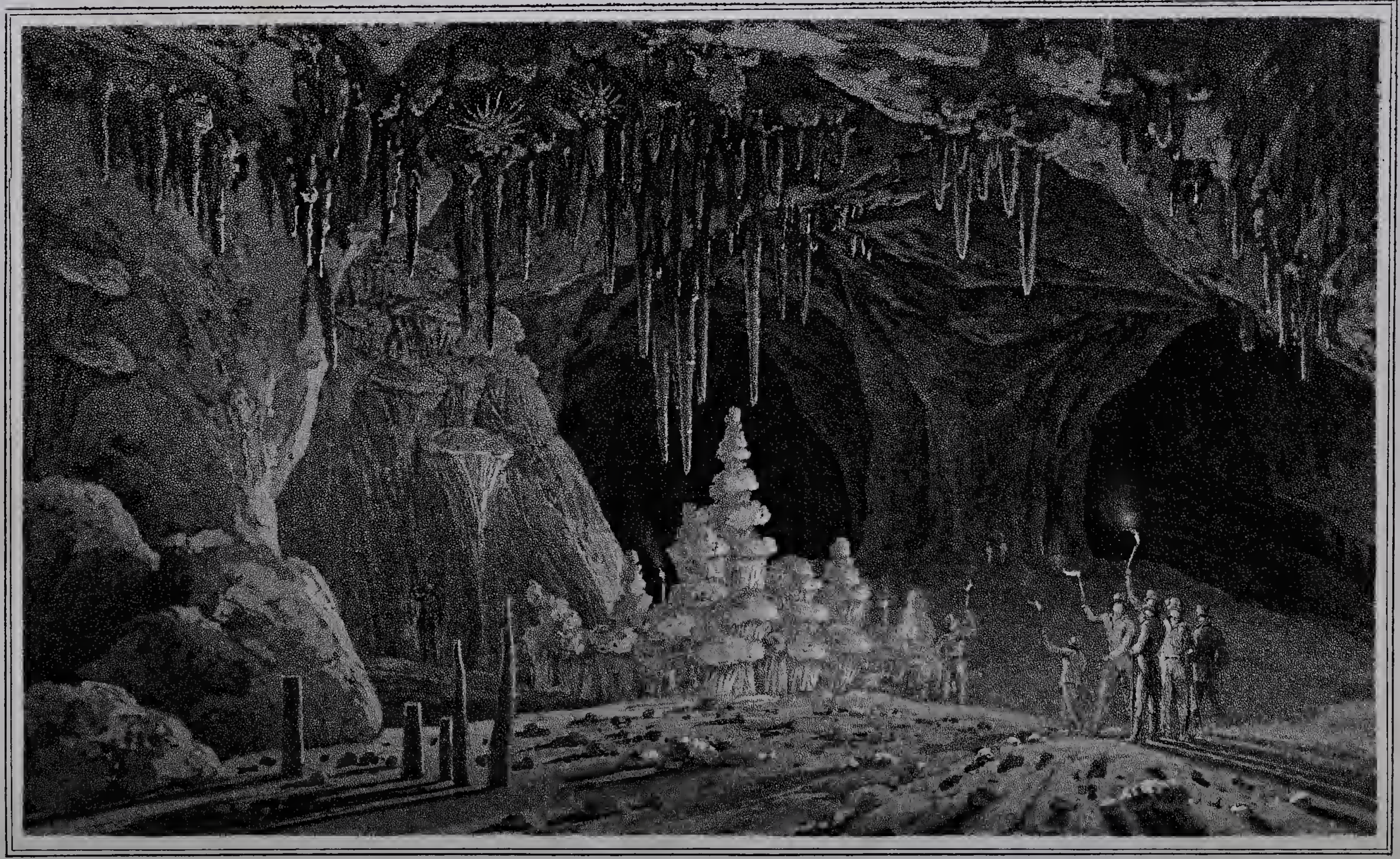
The various layers of earth which are seen as men descend into a mine, differ in their quality in different parts of the world, but all show in some of their strata the particular metal for which the mine has been dug. Gold, silver, copper, tin, lead, iron, and every other metallic substance which we meet with in the bowels of the earth, has a very different appearance in its native state from what it is afterwards taught to assume by human industry. The variety of substances indeed which compose the internal parts of our globe, is productive of equal varieties both above and below its surface. The combination of the different minerals with each other, the heats which arise from their mixture, the vapours they diffuse, the fires which they generate, or the colds which they sometimes produce, are all either noxious or salutary to man. Of these it must be confessed, that the major part are pernicious, and many of them destructive, to the poor wretches who are employed in the mining business. It is only necessary to notice the complexion of most miners, to be satisfied of the unwholesomeness of the place where they are confined. Their pale and sallow looks show how much they suffer from the closeness of their habitation and the many noxious vapours to which they are exposed. We are told that in the quicksilver mines near the town of Idria, in the province of Carniola, in Germany, nothing can exceed the deplorable appearance of the miners. The hospital belonging to the place is said to be full of them, in an emaciated and crippled state, with contracted and paralytic limbs. Dr. Pope, who has given an account of these mines in the second volume of the Abridgement of the Philosophical Transactions, mentions one man who was not in the mines above half a year, and yet whose body was so impregnated with quicksilver, that putting a piece of brass money in his mouth, or rubbing it between his fingers, it immediately became as white as if it had been washed over with that metal. In such a situation it is not surprising that the workmen should be frequently destroyed, and that sooner or later most of them should be killed; but it is a matter of much astonishment that men should be found, who for a trifling reward will expose themselves to almost certain death while they can get employment of a less hazardous nature.

Among the formidable evils which miners in general have to contend with, may be reckoned the noxious gases which are found in mines. These are chiefly inflammable air (hydrogenous gas) and fixed air (carbonic acid gas); they are both very dangerous companions where they abound, and are equally fatal, though they act in different ways. The former frequently plays upon the surface of the water which is found at the bottom of some mines, and immediately takes fire when a torch is presented to it. If the quantity is small the consequences are not to be dreaded; but if it abounds, as is the case in some mines, and a light be inadvertently brought near, the whole explodes with the violence of gunpowder, and blows every thing before it. On this account steel mills have been introduced into mines, which give out sparks of fire in sufficient abundance for the workmen to see by without running any hazard, as inflammable air will not explode from a spark of this sort.

Fixed air is of a nature directly opposite to that which we have just described; for instead of exploding when a torch is presented to it, this gas immediately extinguishes the light. It prevails on the surface of all fermenting liquors, as well as in many mines, and has been known to prove fatal to persons who have incautiously descended into the vats of large breweries. In subterranean places that have been deprived of a free circulation of air, or that have been wholly shut up for any length of time, this pernicious gas is very apt to occur; and as an instance of its fatal effects we shall mention a circumstance which is recorded of some unfortunate persons in Scotland.

Some colliers, working near an old mine that had been long closed up, happened inadvertently to open a hole into it from the pit where they were then employed. By great good fortune, they at that time perceived their error, and instantly fled for their lives. The next day, however, they were resolved to renew their work in the same pit, and eight of them ventured down without any great apprehensions; but they had scarcely got to the bottom of the stairs that led to the pit, when, coming within the vapour, they all instantly dropped down as if they had been shot. Amongst these unfortunate poor men, there was one whose wife was informed that he was stiffled in the mine; and as he happened to be next the entrance, she so far ventured down as to see where he lay. As she approached the place, the sight of her husband inspired her with a desire to rescue him, if possible, from that dreadful situation, though a little reflection might have shown her it was then too late. But nothing could deter her; she ventured forward, and had scarcely touched him with her hand when the damp prevailed, and the misguided, but faithful creature, fell dead by his side.

This fatal vapour, though as invisible as common air, is much heavier, and therefore always floats near the surface of the earth, or immediately upon any thing from whence it may be extricated. This tendency of carbonic acid gas to occupy the lowest place, is particularly evident in the famous grotto del Cane, near the lake d' Agnano, in the neighbourhood of Naples. This natural curiosity is said to be situated on the side of a hill, and that, for the *amusement* of travellers, persons attend at the cave with dogs, which in their turns suffer a temporary death, from which they recover to the astonishment of the spectators. We are assured that the poor animals always seem sensible of the approach of a stranger, and endeavour to get out of the way: however, their attempts being perceived, they are taken and brought to the grotto, the noxious effects of which they have so frequently experienced. Upon entering this place, which is a little cave, or hole, dug into the hill, about eight feet high and twelve feet long, the observer can see no visible marks of its pestilential vapour, only to about a foot from the bottom the wall seems to be tinged with a colour resembling that which is given to stagnant waters. When the dog is held above this mark he does not seem to feel the smallest inconvenience; but when his head is thrust down lower, he struggles to get free for a little; but in the space of four or five minutes he seems to lose all sensation, and is taken out seemingly without life. From this perilous situation, however, he quickly recovers, on being plunged into the neighbouring lake; from whence he is permitted to run home and remain till his turn comes round again.



GROTTO OF ANTIPAROS.

*Designed by W. Daniell.*

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# STALACTITES.

GENERIC CHARACTER.

Calcareous earth fixed by water.

Diaphanous; breaking into fragments of no determinate shape; fracture, when solid, striated; striæ generally diverging from the centre.

SPECIFIC CHARACTER.

STALACTITES SPATOSUS. St. pendulus intus lamellosus diaphanus. *Linn. Syst. Nat. Gmel.* 3. p. 100.

Pendulous stalactite, lamellated within, semi-pellucid.

Stalactites solidus particulis spatosis. *Cronst. Miner.* 1. p. 31.

Spatum molle ex aqua distillante generatum. *Carth. Miner.* 13.

STALACTITES. . . . *Kirw. Miner.* 1. p. 88. *Patrin. Hist. des Miner.* 3. p. 122.

WE occasionally meet with cylindrical pieces of spar attached to the roofs of large caverns, and having the appearance of icicles of different sizes. These are called stalactites, or drop stones, and are formed of chalk, (*carbonate of lime*,) which the water deposits as it drips from the roof. Where clusters of these sparry concretions are collected together, they frequently form grotesque figures, and furnish the curious traveller with ideas of animals, vegetables, &c. These mineral substances are met with only in calcareous soils, where the water which filters through the roofs of the caverns is charged with a quantity of carbonate of lime. The contact of the air and the evaporation which results, precipitates the stony matter, and the drops of water, when they fall to the bottom of the cavern, leave at first merely a little calcareous ring behind them, which increases by degrees till it is changed into a tube with very thin sides. All those who have visited the caverns where the stalactites abound, agree that while they continue tubular their external surface is perfectly dry, and that the drop which is seen depending from the extremity of each stone comes from the interior. In proportion as the cavity of the tube diminishes by the addition of fresh particles of carbonate of lime, the water becomes obstructed in its passage, till at length the channel being completely filled up it can no longer find a passage that way, and therefore drops from the outside. The deposition of earthy matter still continuing in the same degree, soon alters the cylindrical figure of the stalactite, and gives its surface a waved and rude appearance, which, when attentively examined, displays the angles of a multitude of little crystals.

The water that drops from the stalactites is still charged with a portion of carbonate of lime, which it deposits either on the bottom or the sides of the cavern, and which, when it is formed of small thin plates, and has the appearance of a vegetable, is called *stalagmite*. When the same concretion is found in a great mass firm enough to be cut and polished, it is called *alabaster*. It is evident that the composition of these different bodies is the same, and that they are distinguished only by form and situation.

Before the nature of these sparry bodies was known, they were supposed by many to be petrified vegetables, and this supposition may readily be excused when we consider the varied manner in which they are grouped in their native caverns, and attend to their internal structure. All stalactites have a sort of bark, which varies in thickness, and their interior presents an appearance of organization which resembles petrified wood. This resemblance is the more striking when the layers are of two different colours. If we cut a stalactite lengthways, it displays the longitudinal fibres of wood; if transversely, the concentric circles reminds us of the annual growth of vegetables; while the tube in the middle, which is generally of a colour and substance rather different from the rest of the stalactite, represents the pith of the tree.

Pools-hole in Derbyshire is famous for producing stalactites; they are likewise formed in other large caverns in different parts of Europe, but no where, we believe, in such abundance, or in so beautiful a manner as in the Grotto of Antiparos. This immense place, which continues in an inclined direction for 150 feet from the opening, and which is 200 feet high and 250 broad, is studded on all sides by sparry incrustations of a gigantic size.

Antiparos is a little island in the Archipelago, about sixteen miles in circumference, and separated from Paros merely by a narrow channel. The cavern is situated a few miles within the island, and we are said to owe its discovery to Magni, an Italian traveller, who has given such an account of this wonderful place as would hardly be credited, if it had not been confirmed by subsequent visitors. "Having been informed," says Magni, "by the natives of Paros, of a gigantic statue that was to be seen in the little island of Antiparos, it was resolved that we (the French consul and himself) should pay it a visit. In pursuance of this resolution, after we had landed in the island, and walked about four miles through the midst of beautiful plains and sloping woodlands, we at length came to a little hill, on the side of which yawned a most horrid cavern, that with its gloom at first struck us with terror, and almost repressed curiosity. Recovering the first surprise, however, we entered boldly; and had not proceeded above twenty paces, when the supposed statue of a giant presented itself to our view. We quickly perceived that what the ignorant natives had been terrified at as a giant was nothing more than a sparry concretion, formed by the water dropping from the roof of the cave, and by degrees hardening into a figure that their fears had formed into a monster. Incited by this extraordinary appearance, we were induced to proceed still further, in quest of new adventures, in this subterranean abode. As we proceeded new wonders offered themselves: the spars, formed into trees and shrubs, presented a kind of petrified grove; some white, some green, and all receding in due perspective. They struck us with the more amazement as we knew them to be mere productions of Nature, who, hitherto in solitude, had, in her playful moments, dressed the scene as if for her own amusement.

"But we had as yet seen but few of the wonders of the place, and were introduced only into the portico of this amazing temple. In one corner of this half illuminated recess, there appeared an opening of about three feet wide, which seemed to lead to a place totally dark, and that one of the natives assured us contained nothing more than a reservoir of water. Upon this we tried, by throwing down some stones, which rumbled along the sides of the descent for some time, and seemed at last quashed in a bed of water. In order, however, to be more certain, we sent in a Levantine mariner, who, by the promise of a good reward, with a flambeau in his hand ventured into this narrow aperture. After continuing in it for about a quarter of an hour, he returned, carrying some beautiful pieces of white spar in his hand, which art could neither imitate nor equal. Upon being informed by him that the place was full of these beautiful incrustations, I ventured in with him for about fifty paces, anxiously and cautiously descending by a steep and dangerous way. Finding, however, that we came to a precipice which led into a spacious amphitheatre, if I may so call it, still deeper than any other part, we returned, and being provided with a ladder, flambeaux, and other things to expedite our descent, our whole company, man by man, ventured into the same opening, and descending one after another, we at last saw ourselves all together in the most magnificent part of the cavern.

"Our candles being now all lighted up, and the whole place completely illuminated, never could the eye be presented with a more glittering or a more magnificent scene. The roof all hung with solid icicles, transparent as glass, yet solid as marble. The eye could scarcely reach the lofty and noble ceiling; the sides were regularly formed with spars; and the whole presented the idea of a magnificent theatre, illuminated with an immense profusion of lights. The floor consisted of solid marble; and in several places, magnificent columns, thrones, altars, and other objects appeared, as if Nature had designed to mock the curiosities of art. Our voices, upon speaking or singing, were redoubled to an astonishing loudness; and upon the firing of a gun, the noise and reverberations were almost deafening. In the midst of this grand amphitheatre rose a concretion of about fifteen feet high, that in some measure resembled an altar; from which, taking the hint, we caused mass to be celebrated there. The beautiful columns that shot up round the altar appeared like candlesticks; and many other natural objects represented the customary ornaments of this sacrament.

"Below even this spacious grotto there seemed another cavern, down which I ventured with my former mariner, and descended about fifty paces by means of a rope. I at last arrived at a small spot of level ground, where the bottom appeared different from that of the amphitheatre, being composed of a soft clay, yielding to pressure, and in which I thrust a stick to about six feet deep. In this, however, as above, numbers of the most beautiful crystals were formed, one of which particularly resembled a table. Upon our egress from this amazing cavern, we perceived a Greek inscription upon a rock at the mouth, but so obliterated by time that we could not read it. It seemed to import that one Antipater, in the time of Alexander, had come hither, but whether he penetrated into the depths of the cavern he does not think fit to inform us."

Tournefort, in the year 1700, descended into this cavern, and has endeavoured, from what he saw there, to establish his hypothesis of the vegetation of stones. In his Voyage to the Levant he has given a very particular description of the place, which, however, has been superseded by one that appeared in the British Magazine for the year 1746, signed with the name of Saunders. As this account tends to confirm what Magni has said, and is, at the same time, the most circumstantial description extant of this wonderful collection of stalactites, we shall avail ourselves of the opportunity to insert it. Speaking of the grotto, Mr. Saunders says: " Its entrance lies in the side of a rock, about two miles from the sea-shore, and is a spacious and very large arch, formed of rough craggy stones, overhung with brambles and a great many climbing plants, that give it a gloominess that is very awful and agreeable. Our surgeon, myself, and four passengers, attended by six guides with lighted torches, entered this cavern about eight o'clock in the morning, in the middle of August last. We had not gone twenty yards in this cavity when we lost all sight of day-light; but our guides going before us with lights, we entered into a low narrow kind of alley, surrounded every way with stones all glittering like diamonds by the light of our torches; the whole being covered and lined throughout with small crystals, which gave a thousand various colours by their different reflections. This alley grows lower and narrower as one goes on, till at length one can scarce get along it. At the end of this passage we were each of us presented with a rope, to tie about our middles; which when we had done, our guides led us to the brink of a most horrible precipice. The descent into this was quite steep, and the place all dark and gloomy. We could see nothing, in short, but some of our guides with torches in a miserable dark place, at a vast distance below us. The dreadful depth of this place, and the horror of the descent through a miserable darkness into it, made me look to the lane of diamonds, if I may so call it, through which we had just passed; and I could not but think I was leaving heaven to descend into the infernal regions. The hope of something fine at my journey's end tempted me, however, to trust myself to the rope and my guides at the top to let myself down. After about two minutes dangling in this posture, not without much pain as well as terror, I found myself safe at the bottom, and our friends all soon followed the example. When we had congratulated here with one another on our safe descent, I was inquiring where the grotto, as they called it, was. Our guides, shaking their heads, told us, we had a great way to that yet; and led us forward about thirty yards under a roof of ragged rocks, in a scene of terrible darkness, and at a vast depth from the surface of the earth, to the brink of another precipice much deeper and more terrible than the former. Two of the guides went down here with their torches first, and by their light we could see that this passage was not so perpendicular indeed as the other, but lay in a very steep slant, with a very slippery rock for the bottom; vast pieces of rough rugged rocks jutting out in many places on the right hand, in the descent, and forcing the guides sometimes to climb over, sometimes to creep under them, and sometimes round them; and on the left a thousand dark caverns, like so many monstrous wells, ready, if a foot should slip, to swallow them up for ever. We stood on the edge, to see these people with their lights descend before us ; and were amazed and terrified to see them continue descending till they seemed at a monstrous and most frightful depth. When they were at the bottom, however, they hallooed to us; and we, trembling and quaking, began to descend after them. We had not gone thirty feet down, when we came to a place where the rock was perfectly perpendicular; and a vast cavern seemed to open its mouth to swallow us up on one side, while a wall of rugged rock threatened to tear us to pieces on the other. I was quite disheartened at this terrible prospect, and declared I would go back ; but our guides assured us there was no danger; and the rest of the company resolving to see the bottom now they were come so far, I would not leave them: so on we went to a corner, where there was placed an old slippery and rotten ladder, which hung down close to the rock; and down this, one after another, we at length all descended. When we had got to the bottom of this we found ourselves at the entrance of another passage, which was terrible enough indeed, but in this there was not wanting something of beauty. This was a wide and gradual descent; at the entrance of which one of our guides seated himself on his breech, and began to slide down, telling us we must do the same. We could discover, by the light of his torch, that this passage was one of the noblest vaults in the world. It is about nine feet high, seven wide, and has for its bottom a fine green glossy marble. The walls and arch of the roof of this being as smooth and even in most places as if wrought by art, and made of a fine glistering white and red granite, supported here and there with columns of a deep blood-red shining porphyry, made, with the reflection of the lights, an appearance not to be conceived. This passage is at least forty yards long; and of so steep a descent, that one has enough to do, when seated on one's breech, not to descend too quickly: our guides that we kept with us could here keep on each side of us; and what with the prodigious grandeur and beauty of the place, our easy travelling through it, and the diversion of our now and then running over one another whether we would or not, this was much the pleasantest part of our journey. When we had entered this passage, I imagined we should at the bottom join the two guides we had first set down; but, alas! when we were got there, we found ourselves only at the mouth of another precipice, down which we descended by another ladder not much better than the former. I could have admired this place also, would my terror have suffered me; but the dread of falling kept all my thoughts employed during my descent. I could but observe, however, as my companions were coming down after me, that the wall, if I may so call it, which the ladder hung by, was one mass of blood-red marble, covered with white sprigs of rock crystal as long as my finger, and making with the glow of the purple from behind one continued immense sheet of amethysts. From the foot of this ladder we slided on our bellies through another shallow vault of green and white marble, about twenty feet; and at the bottom of this joined our guides.

"Here we all got together once again and drank some rum to give us courage before we proceeded any further. After this short refreshment, we proceeded by a straight but somewhat slanting passage, of a rough, hard, and somewhat coarse stone, full of a thousand strange figures of snakes rolled round, and looking as if alive; but, in reality, as cold and hard as the rest of the stone, and nothing but some of the stone itself in that shape. We walked pretty easily along this descent for near two hundred yards, where we saw two pillars seemingly made to support the roof from falling in; but, in reality, it was no such thing, for they were very brittle, and made of a fine glittering yellow marble. When we had passed these about two hundred yards, we found ourselves at the brink of another very terrible precipice; but this our guides assured us was the last; and there being a very good ladder to go down by, we readily ventured. At the bottom of this steep wall, as I may call it, we found ourselves for some way upon plain even ground; but after about forty yards walking were presented by our guides with ropes again, which we fastened about our middles, though not to be swung down by, but only for fear of danger, as there are lakes and deep waters all the way from hence on the left hand. With this caution, however, we entered the last valley, and horrible work it was indeed to get through it. All was perfectly horrid and dismal here. The sides and roof of the passage were all of black stone; and the rocks in our way in some places so steep that we were forced to lie all along on our backs, and slide down; and so rough that they cut our clothes, and bruised us miserably in passing. Over our heads there were nothing but ragged black rocks, some of them looking as if they were every moment ready to fall in upon us; and, on our left hands, the light of our guides' torches showed us continually the surfaces of dirty and miserable-looking lakes of water. If I had heartily repented of my expedition often before, here, I assure you, I was all in a cold sweat, and fairly gave myself over for lost, heartily cursing all the travellers that had written of this place, that they had described it so as to tempt people to see it, and never told us of the horrors that lay in the way.

"In the midst of all these reflections, and in the very dismallest part of all the cavern, on a sudden we had lost four of our six guides. What was my terror on this sight! the place was a thousand times darker and more terrible for want of their torches; and I expected no other but every moment to follow them into some of these lakes, into which I doubted not but they were fallen. The remaining two guides said all they could, indeed, to cheer us up; and told us we should see the other four again soon, and that we were near the end of our journey. I do not know what effect this might have upon the rest of my companions, but I assure you I believed no part of the speech but the last, which I expected every moment to find fulfilled in some pond or precipice. Our passage was by this time become very narrow, and we were obliged to crawl on all fours over rugged rocks; when in an instant, and in the midst of these melancholy apprehensions, I heard a little hissing noise, and saw myself in utter, and not to be described, darkness. Our guides called indeed cheerfully to us, and told us that they had accidentally dropped their torches into a puddle of water, but we should soon come to the rest of them, and they would light them again; and told us there was no danger, and we had nothing to do but to crawl forward. I cannot say but I was amazed at the courage of these people, who were in a place where, I thought, four of them had already perished, and from whence we could none of us ever escape, and determined to lie down and die where I was.

"Words cannot describe the horror or the extreme darkness of the place. One of our guides, however, perceiving that I did not advance, came up to me, and clapping his hand firmly over my eyes dragged me a few paces forward. While I was in this strange condition, expecting every moment death in a thousand shapes, and trembling to think what the guide meant by this rough proceeding, he lifted me at once over a great stone, set me down on my feet, and took his hand from before my eyes. What words can describe at that instant my astonishment and transport! instead of darkness and despair, all was splendor and magnificence before me; our guides all appeared about us; the place was illuminated with fifty torches, and the guides all welcomed me into the grotto of Antiparos. The four that were first missing, I now found had only given us the slip to get the torches lighted up before we came; and the other two had put out their lights on purpose to make us enter out of utter darkness into this pavilion of splendor and glory. I am now come to the proper business of this letter, which was to describe this grotto. But I must confess to you that words cannot do it. The amazing beauties of the place, the eye that sees them only can conceive. The best account I can give you, however, pray accept of.

"The people told us the depth of this place was 485 yards. The grotto in which we now were is a cavern of 120 yards wide, and 113 long, and seems about 60 yards high in many places. These measures differ something from the accounts travellers in general give us; but you may depend upon them as exact, for I took them with my own hand. Imagine then with yourself, an immense arch like this, almost all over lined with fine and bright crystallized white marble, and illuminated with fifty torches, and you will then have some faint idea of the place I had the pleasure to spend three hours in. This, however, is but a faint description of its beauties. The roof, which is a fine vaulted arch, is hung all over with icicles of white shining marble, some of them ten feet long, and as thick as one's middle at the root; and among these there hang a thousand festoons of leaves and flowers of the same substance, but so very glittering that there is no bearing to look up at them. The sides of the arch are planted with seeming trees of the same white marble, rising in rows one above another, and often enclosing the points of the icicles. From these trees there are also hung festoons, tied as it were from one to another in vast quantities; and in some places among them there seem rivers of marble winding through them in a thousand meanders. All these things are only made, in a long course of years, from the dropping of water, but really look like trees and brooks turned to marble. The floor we trod upon was rough and uneven, with crystals of all colours growing irregularly out of it, red, blue, green, and some of a pale yellow. These were all shaped like pieces of saltpetre, but so hard that they cut our shoes: among these, here and there, are placed icicles of the same white shining marble with those above, and seeming to have fallen down from the roof, and fixed there; only the big end of these is to the floor. To all these our guides tied torches, two or three to a pillar, and kept continually beating them to make them burn bright. You may guess what a glare of splendor and beauty must be the effect of this illumination, among such rocks and columns of marble. All round the lower part of the sides of the arch are a thousand white masses of marble, in the shape of oak trees. M. Tournefort compares them to cauliflowers, but I should as soon compare them to toadstools. In short, they are large enough to enclose, in many places, a piece of ground big enough for a bed-chamber. One of these chambers has a fair white curtain, whiter than satin, of the same marble, stretched all over the front of it. In this we all cut our names, and the date of the year, as a great many people have done before us. In the course of years afterwards, the stone blisters out like this white marble over the letters. M. Tournefort thinks the rock grows like oak or apple-trees for this reason; but I remember I saw some of the finest cockle and muscle shells in the rock thereabouts that ever I saw in my life:—I wonder whether he thinks they grow there too. Besides, if this rock grows so fast, the cavern ought to be all grown up by this time; and yet, according to his measures and mine, the cavern seems to be turned larger since. Indeed, all that I can gather from his account of this glorious place is, that he had drunk a bottle or two too much before he went down into it."

One of the prettiest varieties of these calcareous substances is the *flos ferri*. This is a very beautiful stalagmite, composed of a tuft of little white cylinders interlacing each other like a branched coralline. The name of flos ferri has been improperly applied to this variety, because it is found in mines of iron, though, at the same time, it is composed entirely of carbonate of lime, except a very little oxide of iron with which the base of the branches is generally impregnated.

The most beautiful groups of this mineral are said to come from the mines in Syria, where the specimens have a silky or velvet-like surface, and are composed of converging needles. It is found likewise in several other places, but, for the most part, of an inferior colour.

The other kind of incrustation which we meet with among the stalactites, is formed, like these bodies, of calcareous carbonate, but has obtained the name of *alăbaster*. We are naturally led to suppose, from a proverbial expression, that *alabaster* is a stone of transcendant whiteness; nevertheless, it is very rare to find it perfectly white, as it is generally veined or tinted with different shades of yellow, brown, or red. This assertion may appear rather extraordinary to those who have been in the habit of seeing figures and ornaments of several kinds made of a beautifully white and transparent substance, under the name of alabaster. But this stone, which we so frequently meet with, is of a very different nature. It is formed of chalk combined with sulphuric acid, and known by the name of gypsum. This, when calcined, becomes the common plaster of paris. The true alabaster, on the contrary, is simple carbonate of lime, and of very different chemical properties from the other.

This mineral is not confined to subterranean places where the stalactites abound, but is met with likewise in certain springs, where it generally incrusts whatever is laid in the water. This circumstance has not been lost upon the ingenious artists of those countries where the springs are found, who avail themselves of this incrusting property to form their cameos, bas reliefs, &c. One of the most celebrated springs of this kind is that of the baths of St. Philippe in Tuscany. The water of this spring is very hot, and runs on an enormous mass of stalactite which it has from time to time deposited. From this deposition an Italian artist has modelled several bas-reliefs of a beautiful whiteness. To obtain his deposit he places moulds of sulphur in a very oblique direction against the sides of tubs open at top and bottom. Each of these tubs is surmounted on the superior opening with a large cross of wood. The water of the spring, after having deposited its gross sediment, is conducted above the cross of wood, and dividing as it falls through the tubs, deposits a sediment in the moulds of a very fine texture. It requires from one to four months to form the bas-reliefs, according to the degree of substance it is intended to give them.

The fountain of Saint-Allyre, near Clermont, in Auvergne, is famous for a strong incrustation, like a bridge, which it has thrown over the little stream that runs from it.

Alabaster is sometimes formed in caverns in a very curious manner. Saussure tells us, that when he visited the grotto of Balme on the banks of the

Arve, between Cluse and Sallenche, he was astonished to find that in several places the bottom of the cavern resounded under his feet as if he had been walking on a thin and sonorous vault. This was occasioned by a confusedly crystallized stony substance, like that which hung from the walls of the grotto. Upon examining several little pools of stagnant water which were scattered about the bottom of the cavern, M. de Saussure noticed that a sort of powdery crust at first formed on the surface of the water, which afterwards assumed a more solid appearance, and became hard enough to resist a smart blow with a hammer. The water dropping in abundance through the roof of the cavern, at certain times of the year, forms these little pools which deposit the alabaster. The water at length draining off, leaves the crust perfectly dry; and this it was that surprised Saussure, and made him believe that the cavern had a false bottom.

Fine alabaster is by no means common. The Egyptians get this mineral from the mountains of Thebaid, situated between the Nile and the Red Sea, near a town called Alabastrum. There is said to be a colossal figure of an Egyptian god, in the national museum at Paris, made with this precious alabaster. It is likewise found in several parts of France, particularly a fine red kind in the quarries at Montmartre.

# MARBLE.

### GENERIC CHARACTER.

Compact calcareous earth, admitting of a fine polish.
Fracture foliated; exhibits granular distinct concretions.
Burns to lime: dissolves, with effervescence, in the mineral acids.

### SPECIFIC CHARACTER.

MARMOR MICANS. M. diaphanum album lamellosum intus micans duriusculum in grana subtilia sponte secedens, polituram admittens. *Linn. Syst. Nat. Gmel.* 3. p. 104. no 3.

Hard, white, diaphanous marble, of a foliated fracture, glittering within and breaking spontaneously into little grains: takes a high polish.

Calcareus particulis spatosis dispersis planis irregulariter dispositis nitentibus et marmor unicolor album. *Waller. Syst. Miner.* 1 p. 124. no. 4. a & p. 120. no. 8. a

WHITE MARBLE. *Cronst. Miner.* 1. p 24. *Kirwan. Miner.* 1. p. 114. *Brongniart. Miner.* 1. p. 192.

THE white, or, as it has been called, sugar marble, is the most useful of all the numerous varieties of this beautiful substance. In its fracture it very much resembles hard white sugar, and is frequently as free from impurities; sometimes, however, it is mixed with other substances, and encloses different kinds of stones as well as portions of several metals.

This kind of marble is found in enormous masses, forming beds of very considerable thickness, and often occupying the major part of a mountain. Geologists have, for the most part, considered the white marble as belonging exclusively to crystallized earths, and as coeval with porphyry, granit,&c. This opinion is strengthened by finding it in alternate layers with primitive substances, and always inclined to the horizon in the same degree. The Alps, according to mineralogists, and especially the Pyrenees, exhibit frequent examples of this disposition, where vertical layers of white marble, and beds of granite, may be seen disposed alternately. Similar instances occur at Inverary in Scotland, where this substance has been found under beds of porphyry. As another proof in favour of the supposition, it is alleged that no decayed organic remains are ever found enclosed in white marble.

Among artists this calcareous stone is highly esteemed for busts, statues, &c. and is from thence called *statuary marble.* The most celebrated blocks for this purpose are brought from quarries situated in the isles of Paros, Naxos, and Tenedos, in the Archipelago. The marble from these places has always been in request, and was much employed by the antient sculptors, who used it for some of their most celebrated statues, such as the Venus de Medicis, Pallas de Velletri, &c.

The Carrare marble is still whiter than that from Paros, and appears to have been even preferred by the antient statuaries. Several antique figures are formed of this marble; such as the famous Antinous, a colossal bust of Jupiter; and, according to Dolomieu, the Belvedere Apollo. This sort of marble is, however, by no means confined to the places we have already mentioned; but is met with likewise in France, in Piedmont, in Saxony, in Bohemia, in Norway, in Sweden, in England, &c. But it is rare to find it pure enough for the statuary, though it may be readily employed for other purposes. In the decoration of buildings, the forming of vases, &c. it becomes very useful; and when employed for chimney ornaments it has been remarked, that many pieces have, after a certain time, acquired a sort of flexibility, which has been supposed to be owing to their becoming completely dry, and to the influence of a dilatation and contraction frequently renewed. Several of these marbles have been found to acquire this singular property by a long exposure to the air, assisted by the solar heat, especially upon the tops of some mountains, where this phænomenon has been observed to occur spontaneously.

This singularity in marble has been noticed by Ferber, who, in his Letters on Italy, tells us that in the Borghese palace at Rome, he saw tables of white statuary maible two fingers thick, that were flexible. If these tables are supported vertically and struck on one end, they will vibrate so as to describe small curves; and during these oscillations it is said that the particles of marble may be heard rubbing or grinding against each other.

Saussure has observed several beautiful marbles in Piedmont and in the Milanese. Near Mergozzo he found the quarries of white primitive marble veined with grayish black, of which the cathedral of Milan is built. Sicily furnishes several marbles of different degrees of beauty; the most esteemed are of a deep red colour mixed with white and Isabella yellow. In Spain, as well as in Italy and in Greece, there are entire hills of white marble. One of the most singular phænomena of this kind occurs near Almeria, a maritime town in the kingdom of Grenada, of which Bowles has given the following description: "To form a just idea of this mountain, you must conceive a block of white marble, a league in circumference and two thousand feet high, so pure as to be quite free from any extraneous mixture. The summit is almost flat, and the marble which may be traced in several parts of it does not appear to have suffered any thing from the effect of the air. One side of this mountain is almost perpendicular, and appears like an enormous wall of a thousand feet high, entirely of one piece, and so perfect that the largest crack is not six feet long, and hardly two lines wide."

We know but little of the marbles of Asia. Dr. Shaw, in his Travels, speaks of the marble of Mount

Sinai, and of a reddish kind found on the banks of the Red Sea. Chardin also mentions several varieties found in Persia, of which the most prominent are white, black, and red, or a mixture of white and red.

Marble is common in several of the Chinese provinces, of which many of their bridges are constructed. Twelve or fifteen leagues from Pekin there are quarries of white marble that are worked by the inhabitants into columns and other ornaments to decorate the courts and palace of the emperor.

Many beautiful varieties of marble are found in Siberia, particularly in the environs of Ekaterinbug, from whence it is conveyed into Russia. The late empress built a noble palace of this marble at Petersburgh, for her favourite Orlof. It is situated on the banks of the Neva, and is one of the most striking ornaments of the capital.

It is very common to find marble full of the remains of shells and other calcareous substances. Some specimens of this kind are very beautiful when polished, and much used to ornament chimneys, &c. A gray brown sort, which is almost entirely composed of shells, is found in the neighbourhood of Troyes, in the department of Aube. Another kind, filled with shells of a fine golden yellow, comes from the environs of Astracan; and several other varieties are obtained from different parts of the world.

In the neighbourhood of Florence is found a stone which we may be allowed to mention in this place, as it is known by the name of Florentine marble, and consists of the same component parts. If this stone is cut in a proper manner, its surface will exhibit the appearance of ruined cities, and other singular figures. Many pieces of this Florentine marble are preserved in the cabinets of the curious for the sake of their singularity.

# FLUOR SPAR.

GENERIC CHARACTER.

Calcareous earth united to a particular acid, which when extricated corrodes glass.

Decrepitates with a moderate heat.

Melts in clay crucibles at 130° of Wedgewood's thermometer.

SPECIFIC CHARACTER.

FLUOR CUBICUS. Fl. subdurus nitens lævis lamellosus fragilis in fragmenta pyramidalia dissiliens, cubicus. *Linn. Syst. Nat. Gmel.* 3. p. 128. no. 5.

Crystallized in cubes, moderately hard, with a smooth shining surface; crystals brittle; fracture foliated, breaking into pyramidal fragments.

CRYSTALLIZED FLUOR. *Cronst. Min.* 1. p. 43. sect. 25.

Fluor crystallisatus rhomboidalis. *Waller. Syst. Miner.* 1. 176. no. 4. a.

FLUOR SPAR. . *Kirwan. Miner.* 1. p. 127. *Patrin. Hist. Nat. des Miner.* 3. p. 225. pl. at p. 227. *Brongn. Miner.* 1. p. 243.

THIS beautiful kind of spar generally crystallizes in the form of a perfect cube; sometimes it is found with eight sides, but more frequently between the two extremes. The crystals are often very large, and are principally of a white, violet, blue, green, yellow, or rose colour. Among these varieties there is one in Siberia of a violet colour, which inflames, when thrown on burning coals, and gives a beautiful green light. Pallas has discovered another variety in Catharinenburg, of a pale violet spotted with green: pieces of this spar are so phosphorescent that the heat of the hand is sufficient to make them throw out a white glare, while boiling water produces a green light; and if the experiment is carried further, by throwing some in the fire, bright blue flashes will be produced which extend to some distance round the place. This remarkable property in fluor spar has been ingeniously exhibited by an officer of some mines in Russia. We are informed by Patrin, that he has encrusted the stove of his principal apartment with several pieces of fluor spar, which, when the stove becomes heated, throw out a coloured glare that at night has a very pretty effect. "I was accommodated with this chamber," says Patrin, "and not being aware of the effect, was agreeably surprised with this singular illumination. The light spread by the spar was a beautiful mixture of blue and green, and quite sufficient to render objects visible in the dark."

But the most singular property of fluor spar, and that which has more particularly excited the attention of chemists, is the power which one of its component parts possesses of dissolving flint. This hard substance, which resists every other acid, is obliged to yield to that obtained from fluor, and therefore glass, which is composed of flint united with an alkali, is readily corroded by it. It would be foreign to our purpose to enter into a chemical analysis of this curious substance; nevertheless, we may be allowed to mention the powerful effects of its acid when reduced to the state of gas. A gentleman, who was amusing himself with some experiments on this fluid in a large saloon, was much astonished, when he entered the room the next day, to find that every glass had lost its polish *.

Almost every country in Europe possesses different kinds of fluor spar; but none, we believe, can rival England, either in the quantity or the beauty of this mineral. Saxony and Bohemia are very rich in fluor spar, but Derbyshire and Northumberland are much more so. In these counties it appears under every variety of colour, and often in crystals of an extraordinary size. In the mines at Castleton, in Derbyshire, we meet with it in lumps of more than a foot in diameter, and of cubical crystals measuring two or three inches on every side.

Fluor spar is almost always found in veins mixed with metallic substances, and particularly in those

* This property in the gas has since been employed in order to engrave on glass, and the attempt has so far succeeded, that several impressions, representing chemical vessels, have been struck off for a work lately published.

of lead. Veins of a considerable thickness are often almost entirely filled with this substance, of which the masses present an assemblage of the most lively and opposite colours, the effect of which is very much heightened by streaks of metal passing through the fluor in different directions. All the crystallizations which are found in metallic veins, and especially the groups of fluor spar, are subject to an accident which is worthy of attention: it is, that their surface is sometimes studded with a multitude of marcasites, pyrites, or grains of galena, but always on the lower side, or that which is directed towards the bottom of the mine.

M. Patrin observes, that the fluor spar which is found mixed with the primitive rocks, is generally either in masses or veins without being of any determinate figure; nevertheless, M. Pictet of Geneva has described a fluor spar of a rose colour, formed of crystals of eight sides, which he brought from a rock near the bottom of a glacier, in the valley of Chamouny. The crystals are an inch in diameter, and of a uniform size, in all the pieces observed by M. Pictet. He adds, that similar specimens are to be found in Mount Saint-Gothard, but that they are of a smaller size.

It is singular, that although this mineral is plentiful in several parts of Europe, yet it is rare in the other quarters of the world. Among the numerous specimens of fluor spar which have been described by Romé de l'Isle, who has paid great attention to to their different situations, not one is noticed from the mines of America, or from other distant countries.

In this country, which, as we have already observed, produces the finest specimens of fluor spar, the inhabitants turn it to good account. They form the most beautiful pieces into different ornaments for our chimneys, such as vases or pyramids; sometimes into fruit, egg-cups, &c. The greatest manufactory for these things is carried on in Derbyshire. They turn this brittle substance on a very solid lathe worked by water; and afterwards polish it in the same manner as marble. Patrin laments that this branch of industry is not introduced into France, where they have plenty of the spar which might be rendered equally profitable.

# DIAMOND.

GENERIC CHARACTER.

Extremely hard.
Fracture foliated.
Burns and consumes like an inflammable substance in a certain degree of heat.

SPECIFIC CHARACTER.

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|---|---|
| ADAMAS PRETIOSISSIMUS. | Adamas. *Linn. Syst. Nat. Gmel.* 3. p. 211. |
| | Alumen lapidosum pellucidissimum solidissimum hyalinum. *Mus. Tessin.* 38. no. 3. |
| | Gemma pellucidissima omnium durissima, pulverisata, nigrescens. *Waller. Syst. Miner.* 1. p. 230. no. 1. |
| | DAMANT. *Baum. Miner.* p. 225. |
| DIAMOND. . . . . . | *Cronst. Miner.* 1. p. 123. *Kirwan. Miner.* 1. p. 393. *Brongn. Min.* 2. p. 58. *Patrin. Hist. Nat. des Miner.* 1. p. 224. |

THOSE persons who are totally unacquainted with the operations of chemistry, will not readily believe that the most precious stone in the world is nothing but modified charcoal, and that, far from being indestructible, it may be entirely consumed by fire. Such, however, is the fact; for the knowledge of which we are particularly indebted to the decisive experiment of Mr. Tennant, though other chemists have not been deficient in their operations on the same subject. It was found from some experiments which preceded those of Mr. Tennant, that the diamond, though it was capable of resisting the effects of violent heat in a close vessel, might be consumed when exposed to the joint action of heat and air. These experiments, however, if we except those by Lavoisier, only proved the inflammability of the diamond. Mr. Tennant, and, we ought to add, M. Guyton, went further, and not only proved its combustible nature, but likewise ascertained its component parts. According, therefore, to the present arrangement of minerals, this substance is placed among the combustible bodies: nevertheless, we have taken the liberty to leave it at the head of the precious stones, as a more natural, though less scientific situation than the other.

Diamonds, when brought to Europe in their rough state, are said to be either in the shape of roundish pebbles with shining surfaces, or in octaëdral crystals; but they are not entirely confined to this form, as they vary in several respects, and sometimes occur with twenty-four and even forty-eight sides.

These precious stones are principally found in the East Indies, in the kingdoms of Golconda and Visapour, in the peninsula on this side the Ganges, nearly 18 degrees from the line. They are likewise found in the kingdoms of Pegu and of Siam, in Brasil, and in South America. One circumstance is worthy of remark respecting the situation of diamond mines: it is that those of America are at the same distance in the southern hemisphere, that the Asiatic mines are in the northern. The diamonds of India are in general larger and of a finer water than those of Brasil, but by no means so abundant. As a proof of this, Patrin tells us that when the mines of Brasil were first discovered, the Portuguese were so successful in their researches, that in 1730 the Rio-Janeiro fleet brought away eleven hundred and forty-six ounces. This prodigious quantity, brought immediately into the market, so reduced the price of diamonds, that, to prevent their becoming too common, the court of Portugal afterwards confined the employment of diamond hunting to a certain number of persons.

The account which Tavernier has given us of the diamond mines of Asia is very circumstantial, and deserves our particular attention, as being written by a person who travelled so many years for the sole purpose of collecting diamonds. The first mine he visited was at Raolconda, in the kingdom of Visapour, and the account he gives of this place is nearly as follows:

Round about the place where the diamonds are found, the ground is sandy and full of rocks, which contain veins from half a finger to a finger wide. These veins are full of earth, or sand, which the miners pick out with instruments on purpose, and carefully deposit in a tub, as it is amongst this earth that the diamonds are found. They are sometimes obliged to break the rock in order to trace the veins for the sake of the earth; and as soon as this is accomplished, and all the sand removed, it is carefully washed two or three times, and the diamonds, if there be any, picked out.

There are several diamond-cutters at this mine, but none of them have above one mill, which is of steel. They never cut more than one stone at a time upon each mill, and use oil and diamond powder to facilitate the operation, at the same time loading the stone with a heavy weight.

According to this account of Tavernier's, the Indian lapidaries are very expert in cutting the diamonds, and will frequently undertake to divide a stone, which, from its unfavourable appearance, the Europeans will not venture upon.

Speaking of the government of the mines, Tavernier says they trade very freely and honestly; the king receiving two per cent. on all that are bought, besides a certain duty from the merchants for leave to dig. When these traders have fixed upon a spot they begin their search, and employ a number of miners in proportion to the hurry they may be in. Sometimes a hundred men are employed at once; and when this is the case, the merchant pays four pagodas to the king, for every day they work, and two when the number is not so great.

When Tavernier visited these mines, the poor people never got above three pagodas * for the labour of a year, though they understand their business extremely well. These trifling wages, and the distress they suffer in consequence, make them hide a stone whenever they can find an opportunity: this, it must be confessed, is but seldom, as, besides being strictly guarded, they work almost naked; and therefore, not having any outward protection for their stolen goods, they are sometimes induced to swallow them. When any of these people chance to meet with a large stone, they carry it to the master of the work, who rewards them accordingly.

Every day after dinner, the master of the miners brings the diamonds to the lodgings of the merchants in order to show them; and if the stones are large, or sufficiently numerous to amount to more than the sum of two thousand crowns, he will leave them for some days that the merchants may have time to consider their value, and agree about the price. This it seems they are obliged to do before

* About 1*l.* 5*s.* 6*d.*

the return of the owner, who will never bring the same stones again unless mixed with others.

It appears from Tavernier's account, that the diamond traffic is carried on by persons of all ages, and that even children are taught to barter for them. "It is very pleasant," says this traveller, "to see the young children of the merchants and other people of the country, from the age of ten to fifteen or sixteen years, who seat themselves on a tree that lies in a void place in the town: every one of them has his diamond-weights in a little bag hanging at one side; on the other his purse with five or six hundred pagodas in gold in it. There they sit, expecting when any person will come to sell them some diamonds. If any person brings them a stone, they put it into the hands of the eldest boy amongst them, who is as it were their chief, who looks upon it, and after that gives it to him that is next him; by which means it goes from hand to hand, till it returns to him again, none of the rest speaking a word. After that he demands the price, to buy it if possible; but if he buy it too dear, it is upon his own account. In the evening the children compute what they have laid out: when they look upon their stones, and separate them according to their water, their weight, and clearness. Then they bring them to the principal merchants, who have generally great parcels to match; and the profit is divided among the children equally, only the chief among them has a fourth in the hundred more than the rest. Young as they are, they so well understand the price of stones, that if one of them has made any purchase, and is willing to lose one half in the hundred, the other will give him his money."

The secrecy which the Indians observe in their dealings with each other is singular enough; for they will contrive to sell the same parcel of diamonds several times to each other, without speaking a word; so that no by-stander can possibly tell what they have been doing. The manner in which this is accomplished has been thus described by Tavernier: "The buyer and seller sit one before another like two tailors, and the seller, opening his girdle, takes the right hand of the purchaser, and conveys it, together with his own, beneath his girdle, where the bargain is secretly driven in the presence of many merchants, without the knowledge of any one. The parties never speak or make any signs either with their mouths or eyes, but only converse with their hands; and this is managed in the following manner:—When the seller takes the purchaser by the whole hand it signifies a thousand, and as often as he squeezes it, it means so many thousand pagodas or rupees, according to the money in question. If he takes but half to the knuckle of the middle finger, that is as much as to say fifty; the small end of the finger to the first knuckle signifies ten. When he grasps five fingers, it signifies five hundred; if but one finger, one hundred."

Seven days journey from Golconda towards the East there is another diamond mine called *Gani*, or, in the Persian language, *Coulour*. This mine is said to have been discovered by a countryman, who, digging a piece of ground to sow millet, found a pointed stone that weighed above twenty-five carats. This, being carried to Golconda, immediately induced the inhabitants to search further; and such was the success of their industry, that not only many other stones of considerable size were found, but the wonderful diamond, weighing nine hundred carats, which Mirgimola afterwards presented to Aureng-zeb.

When Tavernier first visited this mine there were above sixty thousand persons at work, consisting of men, women, and children; the men being employed to dig, the women and children to carry the earth.

When the miners have fixed upon the place where they intend to dig, they level another, somewhat larger, in the same neighbourhood, and enclose it with a wall about two feet high, only leaving apertures from space to space, to give passage to the water. The place being thus prepared, the people that are to work meet all together, men, women, and children, with the work-master, his friends, and relations. But before any thing is done, a superstitious ceremony is performed to render their labours propitious. The only passive personage in this ceremony is a little household god which the master brings with him, and before which the people prostrate themselves three times, while the *bramin* says a certain prayer. This being ended, he marks the forehead of every one with a kind of glue, made of saffron and gum, and is careful that the spot is large enough to hold seven or eight grains of rice, which he sticks upon it. Their bodies are then washed with the water which every one brings in his pot, after which they arrange themselves in order to partake of the repast which the work-master has prepared for them; this is merely a plate of rice to each person, with the addition of a quarter of a pound of butter, melted in a small copper pot with some sugar.

After the feast is finished every person proceeds to his business, the men digging the earth in the place first discovered, and the women and children carrying it off into the other, or walled enclosure. When they find water they cease to dig, and the water thus found washes the earth two or three times, after which it is let out at an aperture reserved for that purpose. When the earth has been washed again, and well dried, they sift it in a kind of open sieve; which operation is repeated before they begin to look for the diamonds.

Another mine which Tavernier speaks of as famous for its diamonds is the bed of the river Goual, near *Soumelpour*, a large town built entirely of earth, and covered with branches of cocoa trees. The river Goual runs within a mile of the town, in its way from the mountains towards the Ganges. All our fine diamond points or sparks, called *natural sparks*, are brought from this river, where they are collected as soon as the great rains are over, which is about the end of December. As soon in January as the water is grown clear, eight or ten thousand persons, of all ages and both sexes, come out of Soumelpour and the neighbouring villages. The most experienced among them search and examine the sand of the river, going up it from Soumelpour to the very mountain whence it springs. Those who are used to this business know by the sand whether any diamonds are likely to be found or not, and judge it a favourable sign when they find a number of those stones which we call thunder stones, at the bottom of the river. When they have reason to believe that the produce will pay them for their labour, they proceed to take up the sand, first making a dam round the place with stones, earth, and fascines, and then lading out the water. After this is done, they dig about two feet deep, and the sand thus procured is carried into a place walled round on the bank of the river, where it is washed and sifted in the same manner as at Coulour.

Magellan tells us that the greatest diamond ever known in the world is one belonging to the king of Portugal, which was found in Brasil, and is still uncut. This gentleman was informed from good authority that it was once of a larger size, but that a piece was cleaved or broken by the ignorant countryman who chanced to find the gem, and tried its hardness by a stroke of a large hammer upon an anvil. This prodigious diamond weighs 1680 carats* ; and although it is uncut, Romé de l'Isle says it is valued at 224 millions sterling. This appears to be an incredible sum, and probably this valuation is erroneous; but even supposing that to be the case, and that we employ the usual methods laid down for computing the worth of these jewels, the sum will be immense; as in this way it will amount to at least 5,644,800 pounds sterling!

The diamond which is next in value adorns the sceptre of the emperor of Russia, and is placed under the eagle at the top of it. This stone weighs 779 carats, and is worth at least 4,854,728 pounds sterling, although it hardly cost 135,417 guineas. A singular history is attached to this diamond. It was formerly one of the eyes of a Malabarian idol, named Scheringham. A French grenadier, who had deserted from the Indian service, contrived to become one of the priests of that idol, and, watching his opportunity, stole its eye and ran away to the English at Trichinapeuty, from whence he carried it to Madras. A ship captain bought it for twenty thousand rupees; afterwards a Jew gave seventeen or eighteen thousand pounds for it: at last a Greek merchant, named Gregory Suffras, offered it to sale at Amsterdam in the year 1766, where it was bought by prince Orloff for his sovereign the empress of Russia. The figure and size of this diamond is preserved in the British Museum.

The diamond of the Great Mogul weighs 279 ca-

* A carat weighs four grains.

rats, and is said to be worth 380,000 guineas. This diamond has a small flaw underneath near the bottom; before this stone was cut Tavernier tells us it weighed 900 carats, consequently its loss in cutting must have been prodigious. Another diamond in the possession of the king of Portugal, which weighs 215 carats, is extremely fine, and worth at least 369,800*l*.

The famous diamond which belonged to the late king of France, called the *Pitt*, or *Regent*, weighs nearly 137 carats, and has been valued at 208,333 guineas, although it did not cost above half that sum. This beautiful gem was found in the diamond mines at the foot of the Gaut mountains, about twenty miles from Golconda. Another diamond belonging to the same monarch, called the *Sancy*, was reckoned a very fine stone, though it weighs only 55 carats. It cost 25,000 guineas, but is said to be worth a much larger sum.

We must not omit to mention the diamond of the emperor of Germany, which weighs 139 carats, and is valued at 109,520 guineas. It is of a light citron colour.

It is well known that the diamond is the hardest of all the precious stones, and only to be cut by the assistance of its own powder. We are informed, that to bring it to the degree of perfection which so much augments its price, they begin by rubbing several against each other while rough, after having previously glued them to the ends of two wooden blocks, thick enough to be held in the hand. The powder which is rubbed off the stones in this operation is caught in a little box provided for the purpose, and afterwards used to grind and polish the stones. From the extreme hardness of these stones, it has been alleged that rubbing them against each other is the only way to reduce them to an impalpable powder; but this is not strictly the case, as the jewellers are in the habit of pounding small pieces in steel mortars fitted with a pestle exactly the size of the interior, so that none of the diamond can escape. A few blows with a hammer upon the head of the pestle completely powder the stone.

Diamonds are more or less valuable, according to what is called their *water*. Those of the first water are in the greatest degree of purity and perfection, while those of less brilliancy are said to be of the second or third water, and thus they proceed till the stone becomes coloured; for there are diamonds of all colours, though faintly tinted. Thus we have some of a rose colour; others green, blue, brown, black; and some are marked with black spots.

# GEM.

GENERIC CHARACTER.

A very hard and almost infusible stone, composed of siliceous and argillaceous earth, mixed with a little calx and iron.

## RUBY.

SPECIFIC CHARACTER.

GEMMA RUBINUS. G. durissima ponderosa rubra, texturæ lamellosæ, directione mutata conchaceæ, coloris in igne et tritura tenacissima. *Linn. Syst. Nat. Gmel.* 3. p. 170.

A very hard, heavy, red gem, of a lamellated texture, changing to the conchoidal; retains its colour in the fire, and also when ground to powder.

Gemma pellucidissima duritie secunda, colore rubro in igne permanente. *Waller. Miner.* 111. *Syst. Miner.* 1. p. 325. no. 2.

RUBINUS. *Vogel. Miner.* 143. *Baum. Miner.* 1. p. 22.

RUBY. . . . . *Cronst. Miner.* 1. p. 134. *Kirwan, Miner.* 1. p. 250. *Patrin, Hist. Nat. des Miner.* 1. p. 243. *Brongn. Miner.* 1. p. 436.

WE are told by Patrin that the oriental ruby, the oriental topaz, and the oriental sapphire, which form three different gems amongst the lapidaries, are known by naturalists to be merely varieties of the same stone. They are in effect of the same form, and nearly of the same specific gravity; but what places the analogy in a still stronger light is, that the different colours of the three gems are sometimes found united in the same crystal. According to Tavernier, all coloured hard stones are called rubies in the East Indian mines; and Wallerius, as well as Romé de l'Isle, asserts that the hard and brilliant oriental rubies, sapphires, and topazes, are the very same stone, the colour excepted.

Oriental rubies crystallize in elongated hexagonal pyramids, like those of rock crystal, but much longer.

They are found in Brasil, and in several parts of the East Indies; among other places, the mountain called Capelan, about twelve days journey from Sirian, the capital of Pegu, is famous for them. They are generally discovered in the sands of rivers of a red colour, or in a clayey earth of a greenish colour, and sometimes adhering to red rocks.

The Mogul's throne must be very rich in rubies, if Tavernier is accurate in his account, who tells us that there are 108, weighing from one to two hundred carats each, besides a round one of almost two ounces and a half.

Patrin mentions, from Faujas, the circumstance of sapphires being found in a rivulet that passes through the village of Expailly, near Puy en Velay, which he considers as like those of the Indies. They were found in a ferruginous volcanic sand, with little hyacinths resembling those of Ceylon. "There are," says Faujas, "several sapphires in the ferruginous sands of Expailly, mixed with garnets and hyacinths. I am convinced that they are true sapphires, and not coloured rock crystals, as several naturalists would have us believe."

The *sapphire* is found to vary in colour: it is generally of a transparent blue; but M. Engestrom found some of a milky colour, which, when looked through, varied in the same manner as the milky blueish opals. The late king of France had one with a yellow stripe of a fine topaz in the middle, and some are met with half green and half red.

The sapphire is the third in hardness, the ruby being the hardest of all after the diamond. It becomes electric when rubbed, and is found in Siberia, Bohemia, Alsace, and Auvergne. Romé de l'Isle speaks of one from this last place which was entirely green or blue, according to the side it was looked through. Magellan tells us that sapphires are preferable to common rubies for jewelling the pallets of escapements, and the holes in wheel-pivots, in astronomical watches and clocks, on account of the regular hardness of their substance. A good sapphire of ten carats is valued at 50 guineas. If it weighs 20 carats its value is 200 guineas; but under ten carats its value is estimated at a much lower rate.

The *topaz* is a precious stone of a pale yellow colour, subject to vary, and of a lamellated structure like the other gems. The best kind of topaz is called the oriental, and has the same properties as the ruby and the sapphire. It is found in Pegu, Ceylon, Arabia, and Egypt. A fine variety of this gem is found in Brasil, of a reddish orange colour, and of singular brilliancy. Among others which are brought from that country are some perfectly white, and of so fine a water that Romé de l'Isle supposes, with reason, that the pretended diamond which weighs twelve ounces, in the possession of the king of Portugal, is nothing but a white topaz.

Saxony likewise produces its topazes, which are generally of a straw colour, though they are sometimes met with white, and sometimes with a blueish or greenish tint. They are principally found in a mountain called Schneckenstein, on the frontiers of Bohemia, six leagues to the south of Zwickau. From the summit of the mountain rises a great rock, about eight feet high, which is composed of the same substance as the topaz mixed with other stony matters. In parts of this rock there are a great number of little cavities, where the topazes are found ingrafted in the rock, together with little crystals of quartz, and often covered with yellow ochre. From the circumstance of so many of these stones being found in this place, the German mineralogists have named it *topaz-fels*, or rock of topaz. Other parts of Saxony likewise produce these stones, particularly some granit rocks, which enclose the tin-mines of Zinwald, in Ertzghébirghé, and in Schlackenwald, in Bohemia; but in general they are of a very small size, and often very opaque.

Topazes are found in *Siberia*, in a mountain called the Odon-Tchelon. The superior part of this mountain, whose sides are covered with verdure, is terminated by an abrupt cone, like the summit of a volcano, having on the south-east side a large opening, which resembles a crater. Part of this cone is formed of granit, intersected in many places by masses of argillaceous or ferrugineous substances, in which the topazes are constantly found, though always accompanied with emeralds of various colours. But they are not confined to this part of Siberia alone, as the Uralian mountains produce a considerable number, especially about twenty-five leagues to the north of Ekateringburg, in the environs of Mourzinsk.

In general the topazes of Siberia are of a very pale greenish blue, and become electric when heated. Those of Saxony are of a pale yellow, become electric when rubbed, and are discoloured by fire. The variety found in Brasil are of a lively yellow colour, electric when heated, and turn red in the fire. Such are the principal characters which distinguish these stones from each other; and these are so trifling, that they cannot at best amount to more than mere varieties.

Tavernier mentions a fine topaz belonging to the Mogul, weighing 157 carats; and many others are known of a very large size.

# EMERALD.

SPECIFIC CHARACTER.

Gemma Smaragdus. G. dura pellucida leviuscula coloris graminei in igne in cœruleum abeuntis, refrigeratæ redeuntis, fortiori liquanda, texturæ conchaceæ. *Linn. Syst. Nat. Gmel.* 3. p. 175. no. 13.

A hard, smooth, pellucid gem, of a green colour; becomes blue when heated to a certain degree, but recovers its colour when cold; is of a conchoidal texture, and melts in a very strong fire.

Smaragdus Gemma. *Vogel. Miner.* 145. *Waller. Miner.* 114.

Emerald. . . . *Cronst. Miner.* 1. p. 146. *Kirwan, Miner.* 1. p. 247. *Patrin, Hist. Nat. des Miner.* 2. p. 14. *Brongniart, Miner.* 1. p. 417.

The most beautiful specimens of this precious stone are brought from Peru, where they are found in the jurisdiction of *Santa-Fé*, and in the mountains of the valley of Tunca, which separate New Granada from Popayan. It is said that when the Spaniards first landed in Peru, they found an immense quantity of emeralds in the province of Quito; but they destroyed a great number on an anvil, believing that the true emerald ought to resist a blow with a hammer as well as the diamond. The beautiful deep green colour for which the emeralds of Peru are so eminently distinguished, is apt to vary considerably in different pieces, and sometimes, among a great number of crystals of this gem, not one will be found perfect. The principal defects are fissures which occasionally occur in the stone, and a want of that transparency and lustre which constitutes its chief beauty.

Emeralds are found in different situations in the earth; sometimes they are met with in black limestone, sometimes grouped with crystals of quartz or felt-spar, and occasionally concealed in the cavities which are naturally formed in granit. A most beautiful group of these gems is to be seen at Loretto in the treasure of the holy chapel near Ancona; it is composed of about fifty hexagonal prisms of emerald of an inch in diameter and two inches long, crystallized on a basis of white quartz mixed with mica. There is at present, in the *Museum d'Histoire Naturelle*, an emerald cut in the shape of a dome, which formerly decorated the crown of Julius the Second. It is of a dull green colour, about two inches high, and an inch and a half in diameter. This must have been a native of the old continent, since America was hardly discovered when Julius the second was advanced to the pontificate.

Although Peru is famous for producing the finest emeralds, they are not confined to that country; but are likewise produced in other parts of the world. For instance, in Siberia these gems are found of the same form, the same specific gravity, and the same hardness as those of Peru; but their colour is not so good. The same mountain we have already noticed as producing the topaz, also affords the emerald. On the declivity of the *Odon-Tchelon* there are two layers of emeralds: the first is not far from a rivulet; the second is towards the middle of the mountain. When Patrin visited this spot in July 1785, the countrymen who are employed to collect the emeralds had obtained permission to attend to their agricultural pursuits; nevertheless, with the assistance of a few persons who attended him, he contrived to bring home some interesting specimens. This mineralogist informs us, that the emeralds are found 3 or 400 toises to the north-east of the chrysolites (other gems found in the same mountain), and in a higher situation by 100 toises. He perceived a great fissure in one place, with an opening nearly horizontal, but descending very obliquely into the mountain between two beds of solid granit. This fissure is several feet wide and some fathoms in length. It is full of a ferruginous clay mixed with mica; and in this bed the emeralds are found, not adhering to the granit, but dispersed without order in the argillaceous earth.

Emeralds, in their rough or native state, consist of hexagonal columns, mostly truncated at both ends. "I have," says Engestrom, "samples of both transparent grass green and light green colours, which in a gentle heat become colourless; but white and opaque in a strong fire, without the least marks of fusion."

These stones are distinguished by the jewellers into two kinds, the oriental and occidental. True oriental emeralds are very scarce, and at present found only in the kingdom of Cambay. Those from the western continent, or occidental, are far more common; and some are said to be found in Europe, principally in the duchy of Silesia in Germany.

# GARNET.

SPECIFIC CHARACTER.

| | |
|---|---|
| Gemma Granatus. | G. dura ponderosa rubra texturæ inequalis; igne leniori colorem servans, paulo fortiori in scoriam opacam fuscam spumidam abiens. *Linn. Syst. Nat. Gmel.* 3. p. 176. |
| | A hard heavy red gem, of an unequal texture; retains its colour in a gentle heat, but melts into a frothy opake brown scoria in a strong fire. |
| | Gemma plus minus pellucida, duritie octava, colore obscure rubro in igne permanente. *Waller. Miner.* 117. |
| Garnet. . . . | *Cronst. Miner.* 1. p. 154. *Kirwan, Miner.* 1. 258. *Patrin, Hist. Nat. des Miner.* 2. p. 51. *Brogn. Miner.* 1. p. 594. |

The garnet varies more than any other gem, both in the form of its crystals and in its colour; some being of a deep red, some yellowish, or of a purple tint, and others brown, blackish, and quite opake. They are generally of a spherical form, and never crystallize with less than twelve sides. The prevailing colour is a fine red, and the mean size that of a large pea; though, according to Patrin, they are found from the size of a grain of sand to three or four inches in diameter. Those imbedded in granite are in general of the smallest size, but at the same time the most transparent.

Among the garnets which are called *oriental*, may be distinguished three different shades, known in commerce by as many different names. The garnet of a fine red colour, and free from any mixture, is called a *carbuncle*. That which approaches to an orange is the *soranus* of the antients, and the *vermeille* of the French. Where the fine natural red of the garnet is mixed with purple, the stone has improperly been named the *Syrian*; for it does not come from Syria, but from Siren, a capital town in Pegu.

Garnets are found in almost every country where primitive rocks exist. Switzerland and Bohemia are the two countries in Europe which furnish them in the greatest abundance. Those of Bohemia have a tint of orange mixed with the red, from whence some have given them the name of rubies. These stones are likewise found in Hungary, at Pyrna in Silesia, in Spain, and in Norway. At Bareith, a town in Germany, garnets are found in little irregular masses, of a fine red colour, and abundantly disseminated in a green semitransparent stone called *serpentine*. As they are susceptible of a fine polish, the inhabitants form them into several pretty trinkets and other articles of jewellery.

Black garnets are met with in different situations. Ramond, professor of natural history at Tarbes, collected some from a mountain of the Pyrenees in the neighbourhood of Barége; Romé de l'Isle found them in the diamond mines of Brasil; and Brogniart tells us that they have been discovered in a volcanic rock near Vesuvius, and in the basaltes of Bohemia.

When garnets are perfectly transparent, and hard enough to bear a fine polish, the lapidaries cut them into facets to be employed as jewels. At Meronitz and Trziblitz in Bohemia, there are places where they work the garnets which are found in their neighbourhood. There are work-shops also at Friburg in Brisgaw, for the garnets which are collected from several of the Swiss mountains.

The impure garnets are used to advantage as a flux when they are found near iron-mines, as they not only facilitate the fusion of that metal, but add something to the mass by contributing the portion of iron which generally enters into their composition. The quantity indeed is sometimes so great, that they have been said to yield forty pounds in the hundred weight, and consequently worth smelting alone for the sake of their produce.

# OPAL.

GENERIC CHARACTER.

A hard, smooth, shining stone.
Semitransparent.
Fracture conchoidal.
Infusible by itself, but melts in a strong heat when mixed with mineral alkali, or borax.

SPECIFIC CHARACTER.

OPALUS VULGARIS. *Linn. Syst. Nat. Gmel.* 3. p. 161.

Achates fere pellucida, colores pro situ spectatoris mutans. *Waller. Miner.* 82.

An almost pellucid agate, whose colours change according to the position of the spectator.

Silex vagus, reflectione et refractione varians; albus.

OPAL. . . . . *Cronst. Miner.* 1. p. 157. *Kirwan, Miner.* 1. p. 289. *Patrin, Hist. des Miner.* 2. p. 216. *Brogn. Miner.* 1. p. 500.

THE opal is much esteemed among naturalists for the delicacy of its colours. Buffon ranks it above all the sparkling gems; for although it has neither the hardness nor brilliancy of precious stones, yet its substance is penetrated by the most agreeable colours, which give it a very delicate appearance. Pliny celebrates the opal as possessing all the fire of the carbuncle, the purple of the amethyst, the green of the emerald, sometimes separated, sometimes mixed in the most admirable manner. To these colours may be added the blue and the orange, which frequently join them as auxiliaries, and together form a stone of the most beautiful aspect.

An opal of a considerable size, in all the parts of which the colours are not only brilliant, but properly varied, is so rare a production that it can hardly be estimated at any price. Pliny mentions one which belonged to the senator Nonius, who rather chose to suffer banishment than part with it to Anthony. This stone was in Rome at that time valued at 2000 sestertii.

Cronstedt describes an opal which appears olive-coloured by reflection, and seems to be opaque; but when held against the light is found transparent and of a fine ruby colour. This stone was discovered among the ruins of Alexandria. It is about the size of a hazle-nut, and was bought for a trifle of a French drogoman, and presented to the French consul Lironcourt, who afterwards offered it for sale in several places for the sum of 40,000 rix-dollars.

The opal is found in little masses, in veins scattered among rocks which appear to be partly decomposed, and about the nature of which naturalists seem to be divided; some supposing them to be volcanic remains, others argillaceous rocks, and a third class decomposed porphyry.

Many countries of the world yield this beautiful stone, particularly Saxony, Bohemia, Iceland, Arabia, and the Indies; but the most beautiful, or those which have obtained the name of oriental opals, come from Hungary. One of the most remarkable mines of opal in this last country is situated in a hill at the foot of the mountains near the village of Czernizka, some miles from Eperies. The lava, which serves as a bed for the opals, and which covers one part of the hill, is two or three fathoms thick; and it is observed that the finest opals are always found near the surface, and that they are sometimes turned up by the plough.

The beds which contain the opals are occasionally so penetrated by moisture, that the opals themselves are soft enough to break between the fingers; but when they have been exposed to the sun for a few days they recover their usual hardness, and reassume their beautiful colours. In drying, the stone contracts a number of little fissures, or clefts, by which the rays of light are reflected and decomposed so as to produce all those varied tints for which the opal is so eminently distinguished; and it should be noticed that these tints vary according to the direction in which the stone is viewed. Thus, for example, when an opal reflects the blue or green rays from its surface, if held up to the light and examined in this situation, it will often appear throughout of the colour of fire.

According to Patrin, it is not the little clefts in the opal that alone cause the different colours which are reflected from its surface; for he tells us that, on exposing several opals immediately taken from the mine, they will at first appear equally milky, and exactly alike in texture and fineness. All will become flawed in the same manner by the action of heat; nevertheless, some will acquire the greatest beauty, while others will hardly possess a single coloured ray.

The white and milky opals which reflect no colour, are called *moon stones:* they are very common, and but little esteemed.

# HYDROPHANE.

SPECIFIC CHARACTER.

| | |
|---|---|
| OPALUS HYDROPHANUS. | O. subopacus in liquidis pellucidus coloremque mutans, linguæ adherens. *Linn. Syst. Nat. Gmel.* 3. p. 159. |
| | Subopaque; but becomes transparent when immersed in liquids: adheres to the tongue. |
| | Achates unguium colore in aëre opaca, aqua pellucens. *Waller. Miner.* 83. *Syst. Miner.* 1. p. 283. no. 21. |
| | LAPIDE MUTABILI. *Bruckman.* |
| HYDROPHANE. . . . | *Cronst. Miner.* 1. p. 178. *Kirwan, Miner.* 1. p. 295. *Patrin, Hist. des Miner.* 2. p. 224. *Brogn. Miner.* 1. p. 299. |

THIS very singular stone has attracted the attention of naturalists, for the property which it exhibits of passing from an opaque to a transparent state after being laid in water for a few hours. We owe the discovery of this phænomenon to a German naturalist, who, having several opals of a milky appearance and without colour, thought to improve them by the assistance of acids: the event surprised him; for he perceived that some of these stones, which were perfectly opaque before, became completely transparent after they had been for some time in the acid. It is said he made the most of his discovery, and to augment the price of his stones gave them the pompous title of *eye of the world*; and they are still very generally known both in Germany and other countries, by the name of *oculus mundi* or *lapis mutabilis*.

Mere infusion in any aqueous fluid is enough to render this stone transparent, and therefore water is commonly used as the most convenient for the purpose. As soon as the hydrophane is put into water it exhales a musty smell, several bubbles of air arise, and it gradually becomes transparent. Some of these stones are colourless when transparent, while others assume different tints, such as yellow or red; and some acquire a beautiful mother of pearl colour. Engerstrom notices the hydrophanes which are preserved in the British Museum, the largest of which is about the size of a cherry-stone, though of an oval shape. It is opaque, and its colour like that of a common yellow pea. When this stone has lain in water some hours it becomes transparent, and of a yellow amber colour. This change begins soon after the emersion, and at one end in the form of a little spot, which increases by slow degrees until the whole of the stone has become uniformly clear throughout: when taken out of the water it loses its transparency, first at one end, and then gradually over the remainder, until the whole stone has recovered its former opacity; and this change is effected in less time than the other.

The younger Saussure has found an ingenious way to render the hydrophane transparent by heat as well as moisture. This stone is evidently of a porous nature, and merely becomes transparent by having its pores filled with a fluid; therefore Saussure plunged a specimen of the hydrophane into melted wax, and succeeded with his experiment. When the wax was cold and congealed, the stone was opaque: on the contrary, when the wax became fluid by heat, it was transparent. Among other experiments tried with this stone, it has been found that when plunged in hot water it becomes transparent much sooner, and that the same happens when it is put into very dilute acid. As a proof of the porosity of the hydrophane, Patrin mentions one of an inch in diameter, which is entirely opaque, but acquires in water the transparency and colour of a topaz of Saxony. When it is dry and opaque, it weighs 135 grains; but when it becomes transparent in water it is found to have acquired eight grains, as it then weighs 143. Another of 126 grains when dry is found to increase in the same proportion after it has been for some time in water, where it becomes of an orange colour.

Hydrophanes are found in the same situation as the chalcedony and the opal. The places which are particularly noticed for producing these stones, are Hubertsburg in Saxony, the Isle of Ferro, Telkobania in Hungary, Chatelaudren in France, and the mountain of Musinet, two leagues to the west of Turin. Saussure has mentioned this last place, in his Travels, as producing the hydrophane, and tells us that the mountain is composed of a green serpentine, harder than that of Saxony. Beneath the beds of serpentine are masses of a green magnesian earth, which seem to be nothing more than the serpentine stone in a decomposed state. In these masses are found a number of rolling stones something larger than a cricket-ball, and among them are the hydrophanes, though scarcely one of these is to be met with among a hundred of the others.

# PORPHYRY.

GENERIC CHARACTER.

A hard compound stone of various colours.

## AGATE.

SPECIFIC CHARACTER.

PORPHYRIUS ACHATES. P. ex jaspide, quartzo fragili, crystallo, amethysto, chalcedonio genuino, corneolo et onyche, petrosilice, pyromacho, pluribus vel paucioribus simul compositus. *Linn. Syst. Nat. Gmel.* 3. p. 237. no. 66.

Formed of jasper, brittle quartz, crystal, amethyst; genuine chalcedony, cornelian and onyx, petrosilex, and common flint, mixed together in a greater or lesser proportion.

Achates durissima fere pellucens, diversis coloribus nitens, variegata. *Waller. Miner.* 84. & *Syst. Miner.* 1. p. 284. no. 22.

AGATE. . . . . . *Cronst. Miner.* 1. p. 186. *Kirwan, Miner.* 1. p. 330. *Patrin, Hist. des Miner.* 2. p. 190. *Brogn. Miner.* 1. p. 296.

THE agate is in its texture nothing but a flint variegated with different colours, of sufficient beauty when cut and polished to attract the attention of the jeweller. It is subject to almost endless variety, and is esteemed in proportion to the beauty and elegance of its tints. The onyx, the cornelian, the chalcedony, and the sardonyx, are merely varieties of this stone, which entirely depend for their celebrity on the beauty of their colour. The names which they have obtained are mostly derived from the Greek, as if the business of the lapidary in cutting them, and the fondness of admiring their several beauties and figures, had been derived from that nation alone.

The globular form which agates usually assume is said to be owing to their situation, which is generally in the cavities of rocks. When this is not the case, the stones are either distributed without order in the earth where they are found, or else disposed in interrupted layers or beds. They have likewise been observed in veins of metallic substances as well as in minerals of the most opposite nature, Saussure having noticed them in some granite, near Vienna, while Humboldt assures us that he has met with veins of agate in chalk. According to M. Brogniart, agates are chiefly found in the porphyry and volcanic earths, particularly in the cavities of volcanic tufas, and in porous lavas. In these situations they line the walls of the cavities with very pretty stalactites, and are sometimes formed of round globules as transparent as drops of limpid resin. It is thus they are met with in almost all the volcanic countries, but principally in the Ferro Islands, and in Auvergne.

Although agates may be said to be found in almost every part of the world, yet there are some places particularly famous for them; and one of the chief of these is Oberstein, in the Palatinate. The agates from this place are spread all over Europe, and are best known in mineralogical cabinets. They are found in hills composed of antient lava, the exterior part of which is decomposed, and resembles a mixture of clay, chalk, and oxide of iron.

Agates which are not more than three or four inches in diameter are generally quite solid, and often exhibit, when cut, concentric zones of several colours. These zones approach more or less to the circular or oval shape, and very frequently are so irregular as somewhat to resemble the plan of a fortification. When the balls of this stone are of a considerable size, they are mostly hollow, and the cavities are sometimes very beautifully lined with crystallized pyramids of amethyst. On these crystals are often implanted hexahedral columns of calcareous spar of a grayish colour, forming altogether the most beautiful group imaginable.

Some of these hollow balls of the smallest size have their cavity filled with water, from whence they have obtained the name of *enhydres*. They are found in the territory of Vicentino in Italy, in the middle of a volcanic hill. These little agates, which are not much larger than an almond, contain a drop of water which never entirely fills the cavity, as it may be seen to move when the stone is turned between the fingers.

Besides this very curious circumstance in the agate, we meet with other peculiarities which deserve our notice. Many are very prettily marked within with ramifications of a brown or black colour, which represent trees stripped of their leaves. These stones, which are called *arborescent agates*, are highly prized, and consequently much sought after. When the ramifications run very fine and numerous they are called *dendrites*, and are supposed to be formed by metals in a dissolved state which find their way between the layers of agate, and through imperceptible openings into the very body of the stone. The substances of which these ramifications are chiefly composed, are iron and manganese; and these being purely metallic are easily dissolved in acids. As a proof of this, if an arborescent agate be dipped several times in aquafortis, the dendrites will be totally effaced, and merely leave a white opaque mark behind. Although agate is of a siliceous or flinty nature, and appears to be very compact, yet particular metallic solutions will not only penetrate, but colour it throughout. Silver dissolved in nitrous acid has this property in an eminent degree; for, if a thin piece of agate be immersed for two or three days in this menstruum, and then exposed alternately to moisture and the sun for about a fortnight, the stone will be changed to a pretty violet colour. This may be again discharged by the assistance of aquafortis for twenty-four hours, and afterwards leaving the agate for two or three days in spring water:

by this means not only the artificial colour disappears, but also many of the tints which were natural to the stones.

The agates of Oberstein, those of Deux-Ponts, and in general those of the volcanic hills which are found between the Rhine and the Moselle, very frequently exhibit collections of coloured ramifications which naturalists have compared to mosses, to byssus, or to confervæ, and have even gone so far as to describe the genus and species to which they belong. Although this mode of arranging the stones has been very properly rejected, as the figures are mostly occasioned by metals, yet M. Patrin thinks, nevertheless, that real vegetables have been found enveloped in agate. "I have seen," says this mineralogist, "pieces of stone where this has appeared so evident, that they could scarcely be taken for any thing else. I can almost say the same thing of those agates which contain masses of green filaments resembling confervæ."

The most beautiful arborescent agates come from Surat, in the gulf of Cambay; these, being transported from Mocha in Arabia, have obtained the name of *Mocha stones.*

It is not uncommon to find animal and vegetable substances converted into agate. Patrin tells us that the northern countries are rich in (what he calls) agatised wood, and mentions trunks of trees of a foot in diameter and several feet long, preserved in the cabinet of Vienna, which take a very fine polish. Entire trees converted into agate, were found in the year 1746, near the city of Coburg in Franconia. A portion of the jaw of an elephant also, in the same state, and weighing nearly twenty pounds, has been noticed by La Condamine. But it is not to any particular country that these petrifactions are confined, since they have been met with in most parts of the globe.

Agates are an article of considerable commerce in Germany, where they are formed into a thousand different shapes. Boxes of all kinds, coffee-cups, saucers, knife-handles, seals, and all sorts of trinkets, are there made of agate. There are twenty-six mills employed to polish agates on a river a few leagues from Oberstein, and each mill contains five stones, of an enormous size, and of more than thirty hundred weight. By means of these stones the work is carried on with amazing rapidity. As the agates near this spot are very abundant, the workmen never take the trouble to saw them, but merely give them a blow with a hammer; and this, from much practice, is so dexterously managed, that they generally give the piece nearly the figure they desire, and the remainder of the operation is completed almost in an instant by the mill-stone. There are two hundred and fifty men employed in this business, besides forty masters, who are called goldsmiths, and who first mount the trinkets and then sell them at the fairs of Leipsic and Francfort.

### *Chalcedony.*

This variety of agate, which derives its name from the antient city of Chalcedonia, situated on the eastern side of the Bosphorus, where it was first noticed, and where it is still occasionally found, is of a white colour, like milk diluted with water, and is marked with veins, circles, and round spots.

Chalcedony is found of the same form and in the same situations as the agate: like that stone it frequently occurs in hollow balls lined with crystals of white or violet quartz: sometimes it is found in solid masses of an oval shape. Patrin has recorded some among those which are met with in the form of hollow balls, that exhibit a phænomenon exceedingly curious and very difficult to be explained. On the right bank of the river Chilka, among some volcanic hills, balls of chalcedony are found containing crystals of quartz surmounted by others of calcareous spar. In this there is nothing more than common; but what distinguishes these balls from others is, that all the space which is usually left in the middle of other balls, in these is filled with *maltha*, or black mineral pitch of a solid consistence. It will be extremely difficult to account for the introduction of this inflammable matter, as the stones appear perfectly sound, and without the smallest crack or fissure. To add still more to the singularity of the circumstance, not a vestige of mineral pitch is to be found in the neighbourhood of the stones, which are completely enveloped in a crust of decayed lava. The bitumen is strongly attached to the crystals of calcareous spar, and has even penetrated their substance, while the crystals of quartz are not in the least affected by it. The stones which exhibit this singular phænomenon are four or five inches in diameter, and the quantity of pitch they contain sometimes amounts to several ounces.

In Dauphiny little lenticular chalcedonies are frequently met with, which are called *swallow-stones.* They have obtained this name from being found in swallows' nests, and the country-people, willing to find an use for the stones, suppose the birds collect them to rub the eyes of their brood in order to clear their sight.

### *Carnelian.*

Carnelian is a red variety of agate found among old lavas, and frequently in the neighbourhood of white chalcedony. The most beautiful specimens of this stone are brought from the banks of the Euphrates, near antient Babylon ; they are likewise found of equal value along the Persian Gulf and the Red Sea, from whence they are transported to Surat; and it is by nearly the same route that we procure other stones of a similar nature, and especially the fine arborescent agates. The carnelians of Europe are less esteemed, being generally of mixed tints. They are found in the island of Sardinia, on the borders of the Rhine, in Bohemia, and in Silesia. To be valuable they ought to be of a clear, lively, and equal red colour.

Patrin mentions the carnelians found among the chalcedonies on the banks of the river Amour, as of a very fine paste, but faulty in their colour, which is not of an equal tint; otherwise they would be very much esteemed. When the stone is formed of several layers, some of white chalcedony and others of carnelian, it becomes the *carnelian-onyx*; and when the colours are clean and distinct it forms the cameo, which is so highly prized by the jeweller.

### *Sardonyx.*

It is very difficult to draw the line which separates the carnelian from the sardonyx, as they appear to pass into each other by insensible shades. The stone takes the name of sardonyx when it is of a fine deep orange yellow, approaching to a brown colour: but it is found to vary in the depth of its tint, and sometimes to assume a greenish yellow or olive colour. We are taught to believe by some naturalists that the sardonyx derives its name from the island of Sardinia; but Patrin thinks it more probable that it originated in the city of Sardis, the capital of antient Lydia in Asia Minor, the most beautiful specimens of this stone coming from that part of the world.

The antients are said to have valued these stones very highly, Mithridates having collected four thousand specimens; and as a further proof of the estimation they were held in, Herodotus relates the story of Polycrates, a tyrant of Samos, whose continual flow of prosperity was so great, that his friend the king of Egypt advised him to chequer his enjoyments by relinquishing some of his most favourite objects, that he might not be too much elated by his good fortune. Polycrates complied, and threw into the sea a beautiful seal of sardonyx, the most valuable of his jewels; but a few days after some fishermen brought a fish for the tyrant's table, which having swallowed the seal, it was thus returned to him again. The historian proceeds to say, that when his friend heard this he rejected all alliance with him, from his persuasion that such extreme good fortune would vanish in the end; and that his prediction was verified by the death of Polycrates, who was murdered by Oretes, governor of Sardis, merely, it is said, because the governor wished to put an end to such continued prosperity.

### *Onyx.*

This stone is the hardest of the flinty tribe, and is susceptible of a very fine polish. It consists of different coloured veins, which run parallel to one another, sometimes in straight, sometimes in curved lines. When the stone consists of two veins that run clear throughout, and of distinct colours, it is used for cameos, that is to say, those engraved bas-reliefs, of which the figures should be of one colour and the bottom of the stone of another. The Grecian artists carried this mode of engraving to the highest degree of perfection, and have left some productions to posterity which cannot be too much admired. One of the most celebrated artists in this way was Pyrgoteles, who flourished in the reign of Alexander, and had the exclusive privilege of engraving the conqueror; as Lycippus was the only sculptor who was permitted to make statues of him.

Under the reign of Augustus, the Roman empire produced several very celebrated engravers of cameos; so that from the joint productions of these men a considerable number of engraved gems have been handed down to us, and now contribute to enrich our cabinets. It appears that the antient artists collected their stones for this purpose from Egypt, and that at present they chiefly come from Asia Minor, and Arabia.

There are two kinds of onyx: one is of a pale flesh colour with white lines, or nail-coloured onyx; and the other composed of black and white veins, called the oriental onyx.

# GRANITE.

GENERIC CHARACTER.

A hard compound stone composed of three different substances mixed together in variable proportions.

SPECIFIC CHARACTER.

Granites genuinus. G. ex feldspato, quartzo, et mica compositus. *Linn. Syst. Nat. Gmel.* 3. p. 214.

Composed of felt-spar, quartz, and mica.

Saxum quartzo, spato scintillante et mica in diversa proportione mixtis compositum. *Waller. Syst. Miner.* 1. p. 407.

Petra Mosis. *Hasselq. It.* 526.

Granites durus. *Cronst. Miner.* 2. p. 886.

Granite. . . . *Kirwan, Miner.* 1. p. 338. *Patrin, Hist. des Miner.* 1. p. 86.

To this firm and durable stone we are indebted for the pavement of our carriage-ways. It is this which is used in the streets of London and of most great cities, where we may frequently see it lying in blocks cut from the rock of a proper size for the requisite purpose. The dark shining particles which we observe scattered about in the stone are the mica; the two other essential parts, that is, the quartz and felt-spar, are blended together to complete the composition.

It appears that granite is the most antient of all the rocks, and that it forms the interior part of the terrestrial globe, at least to a greater depth than we have yet been able to penetrate. This has been proved from observation in all the countries of the earth; for granite has ever been found to support the superincumbent strata, and has constantly been met with when every other substance has been penetrated. In the common granite, or that which we are at present describing, and which is by far the most general, the quartz and felt-spar are mixed nearly in an equal quantity, and the mica forms about the tenth part of the whole mass. When the component parts of the stone are united in this proportion, it forms the most durable granite, which suffers but little alteration from the action of the air: if, however, the mica is more abundant, the stone will be more subject to decomposition, and consequently not so lasting. Striking examples of what we have here advanced are noticed by Saussure. This gentleman tells us that in Lyonnois, in Auvergne, in Gevaudan, and in the Vosges, there are many places where the earth is composed entirely of coarse sand, produced by the decomposition of granite, which may be said to form the basis of these provinces. This circumstance is very rarely noticed in the Alps, the granite of those mountains being of a more solid texture.

Although, in general, the granites differ but little from each other in the several countries of the world, yet we find varieties which are sufficiently marked to warrant their being separated from each other; among these we shall proceed to notice the kind which is known by the name of Egyptian or Oriental granite. This is composed of white quartz almost transparent, of great irregular crystals of red felt-spar, and a little blackish mica. The quarries which furnish this fine granite are situated about sixty leagues above Cairo, and stretch to the south as far as the antient city of Syene. It is to these quarries that the Egyptians are indebted for the many remains of obelisks and columns which are yet to be seen in their country, notwithstanding the number that have been transported to Rome. The most beautiful specimen of this kind of granite is still remaining near Alexandria, in the shape of a column, known by the name of Pompey's Pillar, of which the shaft alone with its capital is ninety-six feet high, and twenty-eight feet three inches in circumference. This is, we believe, the most enormous mass of granite that has ever been wrought, since it is formed of a single piece without any joining whatever.

In Italy they have several varieties of granite which they call antique granites, and of which some of their fine columns are composed.

Patrin says that we ought to rank among the oriental granites, the superb violet kind found in the Isle of Elba. It is composed of green felt-spar in large crystals, forming polygonal spots. The pedestal of the equestrian statue on the place of the Annunciation at Florence is of this granite, as well as the base of the chapel of St. Laurence.

Large round blocks of a very fine hard granite, of a red colour, are found in the environs of Petersburg. This stone is called the *granite of Ingria.* When this granite is polished, the felt-spar which it contains appears in large oval or round spots, and with such lustre that the stone seems to be covered with jewels. The public promenade at Petersburg, called the *Summer Garden,* is decorated with a superb colonnade of this granite. This colonnade is described as a most magnificent piece of art. It consists of about sixty columns of the Tuscan order, each of which is about twenty feet high and three feet in diameter. The quay of the Neva, and the magnificent *Canal of Catherine,* are constructed of this granite, which also serves for the pedestal of the statue of Peter the Great. This famous stone was at first thirty-two feet long, twenty-one thick, and seventeen high; but it has been much reduced, in order to make it of a more becoming size.

The blocks of granite found in the neighbourhood of Petersburg are supposed to be the wreck of antient mountains in the province of Ingria, of which scarcely any thing remains but the base.

Corsica produces a very singular and beautiful kind of granite which is full of spots formed of concentric zones composed of quartz, mixed with layers of felt-spar, distributed in rays, which converge towards the centre of the spot. This fine granite has not been as yet discovered in large masses, but is generally met with in little loose blocks.

In Siberia, among the Uralian mountains, we meet with a rock composed of the same elementary substances as the common granite; but instead of the confused crystallization which marks that stone, we find the several materials which contribute to the formation of this kind, disposed in a very different manner. At the bottom of the rock is the felt-spar, of a whitish colour, and of a lamellated and shining texture; the mica is distributed in little elongated nests; and the quartz is disposed in such a manner, that when the stone is cut in a certain direction, its surface bears some resemblance to written characters; from whence it has obtained the name of *graphic granite.*

The other countries which produce this granite are Scotland and the island of Corsica. The first has been described by Doctor Hutton; the second by a French mineralogist. M. Patrin mentions a large specimen preserved in the *Muséum d'Histoire Naturelle*, where it makes part of the collection of rocks from Corsica, which were brought to Paris by Bonaparte, and arranged by Barral.

# SALT.

GENERIC CHARACTER.

Soluble in water.

Decomposed by vitriolic acid, the marine acid of the salt rising in the form of a strong suffocating vapour.

SPECIFIC CHARACTER.

MURIA AQUATICA. M. fixa decrepitans formæ cubicæ aqua soluta. *Linn. Syst. Nat. Gmel.* 3. p. 260.

A fixed salt, crackling when heated; of a cubic form; soluble in water.

α MURIA MARINA. *Waller. Syst. Miner.* 2. p. 55. no. 4. a. b. d.

β MURIA LACUSTRIS. *Cartheus. Miner.* 37.

γ MURIA FONTANA. *Waller. Syst. Miner.* 1. p. 57. no. 5.

δ MURIA THERMALIS. *Linn. Syst. Nat.* xii. 3. p. 98. no. 4.

ε MURIA FOSSILIS. *Waller. Miner.* 2. p. 53. no. 1.

COMMON SALT. *Cronst. Miner.* 1. p. 357. *Kirwan, Miner.* 2. p. 31. *Brogn. Miner.* 1. p. 120.

THE varieties of this useful mineral are distinguished by the different situations in which they are found: thus we have sea salt, rock salt, lake salt, and fountain salt, all possessing exactly the same properties, and containing the same component parts. To those who are unacquainted with the effect of chemical combinations, it will appear strange that a substance of such an agreeable flavour as salt should be composed of the most unpalatable materials; nevertheless, it is really the case, as it is formed by the union of soda with marine acid, either of which taken separately is highly disagreeable.

When salt is suffered to crystallize regularly it takes the form of a cube, and when broken splits into thin plates. It is one of the most abundant substances in Nature, being distributed with a profusion in proportion to our wants, and found in some state or other in every country of the world. The sea is the most abundant mine of this mineral, since it has been ascertained that the thirtieth part of this enormous mass of liquid is formed of salt. The quantity of salt, however, which the ocean contains, is not the same in all climates; it is no where so much charged with this substance as near the equator; and it appears from the observations of Ingenhousz, that the increase from the poles follows a regular progression. The North Seas contain a sixty-fourth, those of Germany about a thirtieth, the Spanish main a sixteenth, and the ocean, within the equator, from a twelfth to an eighth part.

In very hot countries, where the earth is dry and sandy, it is not uncommon to find the surface covered with a crust of salt. This circumstance is mentioned by several travellers. In Persia very extensive plains are said to be covered with a saline efflorescence, especially near Bender-Congo. In Arabia the plains are seldom without salt; and in Africa this substance is so abundantly spread on the ground, that we may presume the dry and hot soil has some share in its formation.

In many parts of the world we meet with lakes of salt-water, whose bottoms are encrusted with a layer of salt. Barrow, in particular, during his travels into the interior of Africa, notices these saline lakes. He met with them to the east of the Cape on the frontiers of the Caffre country, and has given us the following account of their situation: "On the evening of the seventeenth we encamped on the verdant bank of a beautiful lake in the midst of a wood of frutescent plants. It was of an oval form, about three miles in circumference. On the western side was a shelving bank of green turf, and round the other parts of the bason the ground, rising more abruptly, and to a greater height, was covered thickly with the same kind of arboreous and succulent plants as had been observed to grow most commonly in the thickets of the adjoining country. The water was perfectly clear, but salt as brine. It was one of those salt-water lakes which abound in Southern Africa, where they are called *zout-pans* by the colonists. The one in question, it seems, is the most famous in the colony, and is resorted to by the inhabitants from very distant parts of the country, for the purpose of procuring salt for their own consumption or for sale. It is situated on a plain of considerable elevation above the level of the sea. The greatest part of the bottom of the lake was covered with one continued body of salt like a sheet of ice, the crystals of which were so united that it formed a solid mass as hard as rock. The margin, or shore of the bason, was like the sandy beach of the sea-coast, with sand-stone and quartz pebbles thinly scattered over it, some red, some purple, and others gray. Beyond the narrow belt of sand round the margin, the sheet of salt commenced with a thin porous crust, increasing in thickness and solidity as it advanced towards the middle of the lake. The salt that is taken out for use is generally broken up with pick-axes, where it is about four or five inches thick, which is at no great distance from the margin of the lake. The thickness in the middle is not known, a quantity of water generally remaining in that part. The dry south-easterly winds of summer agitating the water of the lake, produce on the margin a fine light powdery salt, like flakes of snow. This is equally beautiful as the refined salt of England, and is much sought after by the women, who always commission their husbands to bring home a quantity of snowy salt for the table.

"We happened to visit the lake at a very unfavourable season, when it was full of water. About the middle it was three feet deep, but sufficiently clear to perceive several veins of a dark ferruginous colour intersecting in various directions the sheet of salt. These were in all probability springs whose action had impeded crystallization, and brought up a quantity of ochraceous matter. I caused a hole four feet in depth to be dug in the sand close to the edge of the water. The two first feet were through sand like that of the sea-shore, in which were mingled small shining crystals of salt. The third foot was considerably harder and more compact, and came up in flakes that required some degree of force to break; and the last foot was so solid that the spade would scarcely pierce it; and one-fifth part of the mass at least was pure salt in crystals. The water now gushed in perfectly clear, and as salt as brine."

Between this spot and the sea, a distance of six miles, Mr. Barrow observed " three other salt-lakes: none of these it seems deposit a body of salt except in very dry summers, when the greatest part of the water is evaporated. The name of Red Salt-pan is given to one of them, on account of the salt produced in it being always tinged of a red colour."

Shaw mentions some salt-lakes near Algiers, which dry in the summer, and leave great masses of this substance at the bottom. In the government of Astracan, from the Caspian sea to the environs of Orenburg, salt-lakes are very common. During the summer, when the heat has evaporated a sufficient quantity of water from these lakes, the salt appears in a crystallized state upon their surface and on their borders. The salt thus formed is often of a deep red colour, and emits a remarkable smell of violets. This singularity is particularly noticed in the lake of Elton, situated above Astracan, which the Kalmucks call the Golden Lake, from the red colour which its saline surface assumes when the sun shines upon it.

Patrin supposes that the salt which is found in these lakes owes its origin to the atmosphere. He says that the most part of the salt-lakes which he has seen in Siberia are placed in such a situation as to preclude every idea of the salt which they contain being formed by any other agent than the atmosphere. This mineralogist produces for an example the innumerable lakes which are found in the great desert of Baraba. This immense desert is surrounded on all sides by two large rivers, the Oby and the Irtysh, which rise near each other in the Altaisch mountains, from whence they spread to the east and west to the distance of a hundred and fifty leagues, and afterwards unite, after a run of about four hundred leagues. The space comprised between these two rivers is not therefore of less extent than fifteen or twenty thousand square leagues, and the soil is entirely composed of a sediment of river sand and clay. The surface is almost every where as level as the plains of Poland, and has scattered upon it hundreds of salt-lakes, which are from a thousand toises to several leagues in extent, besides a vast many ponds of several toises in diameter. Whatever may be the extent of these lakes, their depth never exceeds a few feet. The water which collects in them proceeds from rain, or from the melting of the snow with which this immense plain is covered all the winter. Towards the end of summer, all the lakes as well as the ponds are dry, and covered at the bottom with a crust of salt several inches in thickness. In some the salt is pure, in others there is Epsom salt, (or sulphate of magnesia,) and several exhibit a mixture of both salts. Patrin remarks that the lakes which furnish the marine salt have a good sand for a lining, and that those which produce the Epsom salt have very stinking bottoms. "We can hardly suppose," says this naturalist, "that these lakes are fed by saline springs, since there is not a stratum of salt in the river sediment; and it will be difficult to prove that the springs come from elsewhere; for how is it possible they should pass under the two deep rivers which enclose the desert?"

The circumstances which accompany the different situations of marine salt, either in a fluid or a solid state, exhibit to the geologist peculiarities that are deserving of his notice.

Saline springs are almost always in the neighbourhood of clay, and they frequently exist in countries where rocks of salt are unknown. They also contain other salts, chiefly gypsum and sulphate of soda, or Glauber's salt; it must likewise be remarked, that after great rains the springs not only increase in quantity, but also become more strongly impregnated with salt; from whence we may be allowed to suppose that the salt is generally formed in the earth from whence the water issues. Again, there are springs which seem to follow the variations of the barometer, and become stronger or weaker, in proportion as that instrument rises or falls. Others diminish in very cold weather and increase in hot, without being sensibly affected either by a wet or dry season.

Salt springs are very numerous, and occur in most parts of the world. Those of our own country, situated at Northwich, are well known for the great quantity of salt which is annually obtained from them. The springs are from twenty to forty yards below the surface of the earth, and the water is raised by the assistance of a steam-engine, and conveyed through long troughs to the brine-pits, where it is evaporated in large iron pans till the salt crystallizes. An immense quantity is collected in this way, no less than 45,000 tons being annually manufactured in the town of Northwich.

We must now proceed to mention the rock salt, or sal gem; which, for the immense rocks of it that occur in different countries, and the mines that are excavated for the purpose of obtaining this useful commodity, becomes an object highly deserving our attention.

The name of sal gem has been given to this kind of salt on account of its more than ordinary hardness, and that it sometimes assumes the colour and almost the transparency of a precious stone. Beds of sal gem are found considerably below and as much above the surface of the earth. At Wielitska in Poland we descend for this mineral to the depth

INTERIOR OF A SALT MINE.

*Designed by W. Daniell.*

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of more than six hundred feet; in Spain we find it both on a level with the plains, and several hundred feet above; in Tirol it is still more elevated, and in Peru it is found on the summit of the Andes, more than two thousand fathoms above the surface of the sea.

The only mines of rock salt in *England* are those near Northwich, in the county of Chester, discovered, about a mile from the town, in the year 1670. The beds of salt in these mines are found from 80 to 140 feet below the surface of the earth. They vary in thickness, and lie in an undulating or waved direction. We learn from some observations made upon the spot, that the first stratum, or mine, is from fifteen to twenty-one yards in thickness, in appearance resembling brown sugar candy, perfectly solid, and so hard as to be broken with great difficulty by iron picks and wedges. This part of the business, however, has lately been much accelerated by gunpowder, with which the workmen loosen and remove many tons together. Beneath this stratum is a *bed of hard stone* *, consisting of large veins of flag, intermingled with some rock salt, the whole from twenty-five to thirty-five yards in thickness. Under this bed is a second stratum, or mine of salt, from five to six yards thick; many parts of it perfectly white, and clear as crystal; others brown; but all less impure than the upper

* This must be considered as a very singular occurrence, and perhaps the only instance where a stratum of *hard stone* has been found between layers of salt.

stratum. The whole mass of salt is covered by a bed of whitish clay, used in the manufactory of Liverpool ware.

The same observer informs us that rock salt-pits are sunk at a great expense, and are very uncertain in their duration; being frequently destroyed by the brine springs bursting into them, and dissolving the pillars that support the roof; through which the whole work falls in, leaving vast chasms in the surface of the earth. In forming a pit, a shaft or eye is sunk, similar to that of a coal-pit, but more extensive. When the workmen have penetrated to the salt rock, and made a proper cavity, they leave a sufficient substance of the rock (generally about seven yards in thickness) to form a solid roof; and as they proceed they hew pillars out of the rock to sustain the roof, and then employ gunpowder to separate what they intend to raise. This is conveyed to the surface in large craggy lumps, drawn up in capacious baskets made for the purpose. The largest rock salt-pit now worked is in the township of Wilton, near Northwich. This has been excavated in a circular form 108 yards in diameter; its roof is supported by twenty-five pillars, each three yards wide at the front, four at the back, and its sides extending six yards. Each pillar contains 294 solid yards of rock salt; and the whole area of the pit, which is fourteen yards hollow, includes 9160 superficial yards, being little less than two acres of land. We may easily conceive that when this wonderful place is well lighted up, the reflection of the torches from so many brilliant surfaces must have a very surprising effect. A constant current of fresh air is communicated to the workmen by means of a tube at the mouth of the pit, with a pair of large double bellows fixed to it.

*Hungary* and *Poland* produce several mines of sal gem, of considerable magnitude; but the most famous among them, and indeed the most celebrated in Europe, are the salt-mines of Wielitska, about two leagues to the south-west of Cracow. According to the local description of these mines, which has been given by several naturalists, we find that immediately under the common soil there is a layer of clay, which is succeeded by sand to the depth of thirty feet: after having passed another layer of clay of a black colour and very compact texture, we arrive at a mixture of sand and salt, sometimes in grains, sometimes in lumps of a very considerable size, and several feet in diameter. At the depth of 150 or 200 feet we find the regular layers of salt, which are at first very thin, but gradually increase in thickness, and are separated from each other by strata of sand, marle, and pebbles. The descent into these mines is by six wells, and in the interior are several small chapels excavated in the salt, where mass is said at certain times of the year. One of these chapels is above thirty feet long, and twenty-five broad: an altar, a crucifix, and various ornaments and statues, are all carved out of the salt. The immense size of the different excavations or chambers, with the spacious passages or galleries, the chapels above mentioned, and a few sheds built for the horses, which are foddered below, have given rise to the exaggerated accounts of travellers, that these mines contain several villages, inhabited by miners who never see the light. Although these accounts are totally without foundation, yet, according to the most authentic descriptions of this place, there is room enough for such purposes, the mines being of a stupendous extent, and perfectly dry, except a small spring of fresh water which runs along the bottom. They have been worked since the year 1251, and the miners are constantly relieved every eight hours.

Mr. Coxe visited these famous mines before he left Poland; and as his description of the place is from actual observation, we shall subjoin as much of it as is necessary for our purpose. "Upon our arrival at Wielitska," says this traveller, "we repaired to the mouth of the mine. Having fastened three separate hammocks round the great rope employed in drawing up the salt, we seated ourselves in a commodious manner, and were gently let down 160 yards below the first layer of salt. Quitting our hammocks, we passed a long and gradual descent, sometimes through broad passages or galleries capable of admitting several carriages abreast; sometimes down steps cut in the solid salt, which had the grandeur and commodiousness of the stair-case in a palace. We each carried a light, and several guides preceded us with lamps, the reflection of which, from the glittering sides of the mine, was extremely beautiful; but did not cast that luminous splendour which some writers compare to the lustre of precious stones.

"The salt is called *ziebna*, or green salt, though the colour is iron gray, and when pounded appears like our brown salt. The quality improves in proportion to the depth. Towards the sides and surface, it is mixed with earthy or stony particles; lower it is said to be pure, and to require no process before it is used. The finest of this gray salt, however, is of a weak quality when compared with our common sea-salt; it is therefore undoubtedly by no means pure, but blended with extraneous particles, though it serves for common purposes. Being almost as hard as stone, the miners hew it with pick-axes and hatchets, by a tedious operation, into large blocks, many of which weigh six or seven hundred pounds. These masses are raised by a windlass; but the smaller pieces are conveyed up by horses along a winding gallery, which reaches to the surface of the earth. Beside the gray species, the miners sometimes discover small cubes of white salt, as transparent as crystal, but not in any considerable quantity: they find occasionally pieces of coal and petrified wood buried in the salt."

About five leagues to the south-west of Cracow are the salt-mines of Bochnia, of the same depth, and almost as famous as those of Wielitska, but the salt which they yield is not so pure.

At Soowar in Hungary there are also considerable mines, of which Dr. Bruckman has left us the following desciption: "July 16, 1724, we came to Soowar to view the celebrated salt-work, which furnishes the finest salt of the whole kingdom. Having communicated our intention to an officer of the salt-work, and asked his leave to go into the cuts, he gave us two guards for guides. We first descended about forty fathoms into the well by a rope, seated on what they call leathern dogs; after which we again descended one hundred fathoms by holding ourselves against the wall and sides of the wells; and so continuing our journey under ground we found ourselves at last in the cuts, and saw all the alleys cut in the finest rock-salt. They draw it up by a rope and put it into a reservoir, where they cleanse it with salt water. They boil it afterwards with the same water until it becomes of the consistence of crystal, and then put it into vessels containing about 268 pounds weight each, which they send into Silesia and other countries. There is in this mine one very remarkable thing, and that is a chapel, which can easily contain a hundred people, with an altar, a pulpit, sacristy, chairs, and forms, all cut in the salt-rock. In this chapel they celebrate divine service once every year, the week after Epiphany, for the officers of the excise and the miners."

The salt-mines near Halle, a town on the banks of the Inn, are on the top of a very high mountain. The salt is formed in irregular masses, inclosed in the fissures, and between the laminæ of the upper part of the mountain, which is of a slaty nature. The salt is extracted from this mine in a very peculiar manner. The workmen penetrate into the mass by forming parallel galleries; into these they introduce a quantity of water, which is left there for several months. When the water is supposed to be completely saturated, they conduct it from the gallery through a trough, and evaporate the solution. The walls and lumps of salt which support these subterranean passages, being partly dissolved by the water, give way, and the earth falls in; but in a few years the rubbish becomes solid, and the passage is again explored.

*Spain* is rich in salt-mines, three of which are described by Bowles in his Natural History of Spain. The first which he mentions is situated in a mountainous country between the kingdoms of Valencia and Castile. The depth of the mine is unknown, since they have already penetrated three hundred feet below the surface, but cannot proceed any further on account of the expense which attends the extraction of the salt.

The second mine is in Spanish Navarre, in a chain of hills that extend from east to west. This chain is more than two leagues in extent, and in the most elevated part is situated the village of Valtierra, on one side of which we find a mine of sal gem.

But the third mine which he mentions is by far the most curious. It is near Cardona, a town of Catalonia, about thirty miles from Barcelona, and is literally a rock of solid salt, which rises four or five hundred feet above the surface of the earth, without any fissure, crevice, or separation into layers, or beds. This immense block is about a league in circumference, and rises as high as any of the neighbouring mountains: how far it may be sunk within the earth must be for ever unknown.

We have thus enumerated the principal mines of salt, though almost every country contains more or less of this mineral; and among others Peru deserves to be named on account of the remarkable position of its mines, which are situated in the most elevated part of the Andes.

# NITRE.

GENERIC CHARACTER.

Very soluble in water.
Decomposed by vitriolic acid, the acid of the nitre rising in acrid suffocating vapours.
Detonates when thrown on burning coals.

SPECIFIC CHARACTER.

| | |
|---|---|
| Nitrum nativum. | N. fixum nudum, purum, non deliquescens; aqua, qua solutum fuerat, exhalante, crystallos hexaedro-prismaticas utrinque pyramide hexaedra inæquali terminatas exhibent. *Lynn. Syst. Nat. Gmel.* 3. p. 262. |
| | A pure fixed salt, not dissolving in the air; soluble in water; crystallizes in the form of six-sided prisms terminated by six-sided pyramids. |
| Native Nitre. . | *Cronst. Miner.* 1. p. 344. *Kirwan, Miner.* 2. p. 25. *Brogn. Miner.* 1. p. 112. |

This saline substance, so well known in commerce by the name of saltpetre, is found in a native state in several parts of the world, generally under the form of an efflorescence composed of extremely delicate needles, called by the French *salpetre de* *houssage.* It is a neutral salt formed by the union of nitrous acid and fixed vegetable alkali, or potash, and although so abundantly diffused in Nature, is very rarely crystallized in the form obtained by means of art, and noticed in the specification.

Most countries produce nitre, but not in considerable masses; and it may be remarked that, contrary to sal gem, it is very rarely if ever found within the earth, being always confined to the surface; and therefore we may reasonably suppose that the air is indispensably necessary to its production.

Chalky plains which are dry and much exposed to the sun, as well as sandy situations which contain chalk, are frequently covered with a crust of nitre. Thus it is found in considerable quantities in several plains in Spain, as well as in Hungary, which appears to be a most productive salt country, since it contains the finest mines of sal gem, as well as great abundance of nitre. This salt is found on the surface of the soil to the north-west of Debretzin; besides which there are nitrous waters about thirty feet deep in several parts of this country.

But the most remarkable collection of native nitre is that in Italy, discovered by the Abbé Fortis in the year 1783. It is situated at Molfetta in a hollow called the Pulo. In this hollow, which is about one hundred feet deep, there are several natural grottos; in the interior part of which, between strata of compact limestone, nitre is found regularly crystallized. The stone itself is so richly impregnated with it that it bursts in many places, and forms white efflorescences and crusts resembling canary sugar, mixed with gypsum on its surface: when these efflorescences are scraped off, more is generated in the space of about a month, but more quickly in summer than in winter. The nearly horizontal calcareous beds, whose edges appear in the interior of the Pulo, vary in thickness from half an inch to six feet. The stone of which they are composed is very compact, and abounds in marine bodies converted into calcareous spar. It is the thickest of these layers which are dug into the form of grottos, and the openings into these are said to be much smaller than the interior. Fortis tells us, that from those grottos where the entrance is so small as hardly to admit a child with a lanthorn in his hand, they collect the finest saltpetre.

Van Egmont assures us, that nitre is not only found in all those parts of Egypt which are washed by the Nile, but also in several other places which are not influenced by the waters of that river. The earth containing this salt is sometimes known by its whitish surface, but it is often to be detected only by its saltish taste. The saltpetre used all over Egypt is extracted from this earth, and the places where it is found are considered as mines belonging to the Grand Signor. They are worked on his account, and therefore any person detected in embezzling the salt is sure to be severely punished. "In going to Cairo," says Van Egmont, "there are several villages on the banks of the Nile, where the inhabitants are chiefly employed in making saltpetre."

The Americans collect a considerable quantity of the saltpetre, with which they make their gunpowder, from caverns in the mountainous parts of Kentucky. These grottos are met with on the sides of calcareous hills, and the earth which they contain is very full of nitre.

Besides the places which we have enumerated, nitre is found in Persia, in India, in Arabia; especially in a valley between mount Sinai and Suez. In Africa, to the south of the cape of Good Hope, on the sandy Karroo desert; and in South America, where the dry pastures near Lima are covered with a nitrous efflorescence.

The three circumstances mentioned by naturalists as principally conducive to the formation of nitre are these: first, the presence of chalk, or some calcareous substance; in this manner, according to Fourcroy, the nitre is formed which appears on the surface of old walls covered with plaster, and from this circumstance great quantities of nitre are usually found in the remains of old buildings. We have already noticed, that in nature this substance is chiefly found in calcareous situations; and we may add, as a further confirmation, that the Duke de la Rochefoucault has obtained it in the proportion of an ounce to a pound from the chalk of Roche-Guyon.

The second circumstance favourable to the production of saltpetre is the putrefaction of animal and vegetable matters. It is well known that stables, dunghills, and other places containing decayed animal or vegetable substances, afford abundance of this salt. Beds for the artificial production of nitre have always been established upon this principle; and the manner which is pursued to effect the purpose has been thus described: ditches or covered sheds are formed, and left exposed on all sides to the air; these are then filled with vegetable substances and dung of all kinds, the mass being stirred from time to time to expose a fresh surface to the action of the air, and water occasionally poured upon it. When the putrefaction is considerably advanced, a small portion of the matter is washed in order to detect the nitre which it may contain; and if it is found sufficiently abundant, the whole mass is treated in the same manner.

Air is the third agent which seems especially requisite to the formation of nitre. This is said to be a principal cause of the saline efflorescence on the surface of walls; and it is to receive all possible assistance from this element, that the mixture deposited for the production of artificial nitre is so frequently stirred.

The following method is commonly used to extract this salt from the substances in which it is formed. It is necessary, however, to premise that nitre dissolves very easily in water, which when boiling takes up a quantity nearly equal to twice its own weight; and upon this principle alone, the salt is extracted from the rubbish that contains it.

The saltpetre-makers, after having pounded the plaster or rubbish, put it into a vessel with a hole at the bottom, and cover it with ashes. Through this they pour water already impregnated with nitre, in order that it may be completely saturated; after which the lixivium is evaporated in copper vessels. The first pellicles which they skim off during the evaporation, consist only of the marine salt contained in the rubbish, called *grain*; and this, it appears by their regulations, they are obliged to carry to the refining-houses. When the water is evaporated to such a degree that the residue when cool must become solid, they put it into other vessels in which the nitre is crystallized. This salt, which is very impure and dirty, is called *nitre of the first boiling*, and contains several other salts besides saltpetre. The mixture is separated from these extraneous substances by dissolving it in the smallest possible quantity of water, and clarifying the boiling liquor with bullocks' blood, which collects all the impurities on the surface in the form of scum. The lixivium is then evaporated, and a much purer nitre obtained from it, called *nitre of the second boiling*. This, however, is yet vitiated by a certain quantity of other salts, from which it is purified by a third boiling; when it is made to crystallize very rapidly, and forms large masses at the bottoms of the vessels, while long regular crystals appear in the middle, which are called *nitre in sticks*, and in this state it is used in commerce.

Since the invention of gunpowder the demand for nitre has exceedingly increased, this salt being the principal ingredient in that destructive composition.

# BITUMEN.

GENERIC CHARACTER.

Very inflammable; burns with a thick smoke, and exhales a strong smell.

SPECIFIC CHARACTER.

| | |
|---|---|
| Bitumen Naphtha. | B. fluidum albicans volatile maxime inflammabile. *Linn. Syst. Nat. Gmel.* 3. p. 277. |
| | A fluid bitumen of a whitish colour; volatile and very inflammable. |
| | Bitumen fluidissimum levissimum. *Waller. Syst. Miner.* 2. p. 89. no. 1. |
| | Oleum montanum ignem attrahens. *Wolters. Miner.* 24. |
| | Naphtha albicans. *Kæmpf. Amœn. Exot.* 273. |
| Rock Oil. . . . | Naphtha. *Cronst. Miner.* 2. p. 465. *Kirwan, Miner.* 2. p. 42. *Brogn. Miner.* 2. p. 19. |

The different bituminous substances, such as naphtha, petroleum, maltha, and asphaltum, may be considered rather as varieties of each other, depending upon their different degrees of solidity, than as distinct species. We shall therefore describe them all under the head of bitumen, giving naphtha the preference, as being the most fluid and the least common.

Naphtha is perfectly fluid and diaphanous; it has a very strong smell, not much unlike the volatile oil of turpentine. It is rather unctuous to the touch, and so very light as to float on water. It catches fire very readily, and burns with a blueish flame and thick smoke till it is almost entirely consumed.

It is the rarest of the bitumens, and is scarcely ever found in nature in a state of perfect purity: that which is used for commercial purposes is generally adulterated with oil of turpentine. We are told, that in Persia it is more common than elsewhere, especially on the banks of the Caspian sea near Baku. The inhabitants of that neighbourhood take advantage of the volatile and inflammable vapour which rises from the earth where the naphtha is found, and kindle it to serve them as a natural fire for their culinary purposes. It is said also, that they employ it to burn their lime; from which we may conclude that the vapour is very active. About six hundred yards round the place where these perpetual fires are burning, the people dig wells of thirty feet deep, where they collect the naphtha, which is not perfectly limpid, but of an amber colour. This is distilled, to extract the pure naphtha used in medicine. After the bitumen has undergone this process, there remains a blackish residuum, which serves the Persians to burn in their lamps. This naphtha, and the petrol which accompanies it, produces the Khan of Baku a revenue of near ten thousand pounds.

Naphtha is likewise found in Calabria, in Sicily, in America, &c.; but it must be observed, that the travellers who have noticed the bitumen in these places are very likely to confound it with the variety which we shall next describe.

A spring of yellow naphtha, very inflammable, and burning away without leaving any residuum, was discovered in the year 1802, near the village of Amiano, in the duchy of Parma. This source is sufficiently abundant to furnish the necessary quantity of naphtha to illuminate the city of Genoa. But when the oil is used for this purpose, it behoves the persons employed to be very careful of their reservoir, lest by approaching too near with a light they should inflame the whole quantity.

Petroleum is so nearly allied to naphtha, that it is only to be distinguished from it by being somewhat thicker, and of a darker colour. Like naphtha it is very inflammable, burning with a thick black smoke, and leaving hardly any residuum.

In *France* there are several places which produce this mineral, particularly at Gabian, a village in the department of Herault, where the petroleum is found floating on the surface of some water, and is known in commerce by the name of oil of Gabian. It is likewise found in Auvergne, near Clermont; in the department of Landes, near Dax; and in the salt springs in the department of the Lower

Rhine. Wells are dug in some of these places 120 feet deep, where they find the petrol mixed with sand in the proportion of about ten pounds in the hundred weight. To extract the bitumen from its earthy bed the workmen put the sand into large coppers, where it is mixed with water and boiled. The bitumen separated by this means is afterwards distilled, and pure petroleum obtained from it.

At mount Zibio near Modena, in *Italy*, the springs containing petrol are situated in the bottom of a valley, and are enclosed by a friable rock, composed of a mixture of clay, chalk, and sand. The petrol swims on the surface, but scarcely makes its appearance in the winter, when the water is most abundant. Wells are dug to receive the water of the springs, from whence the floating petrol is drawn up in buckets.

In *India*, the kingdom of Ava produces abundance of petrol. The principal place is on the river Ava, about three miles from Erraouaddy, where it is said there are five hundred wells in one hill. At about 180 feet below the surface of the ground they find a bed of coal, from whence the petrol proceeds, and this is drawn up from the bottom of the wells in iron buckets. The heat of those wells is so excessive, that we are assured the workmen are constantly in a state of perspiration.

*England* produces this mineral, and some is found in *Scotland*, but not in such abundance as in other countries.

Maltha is of a blacker colour and of a thicker consistence than petroleum, becoming almost solid in cold weather. Besides the smell which is peculiar to bitumens in general, it possesses the other properties of these inflammable substances, burning with abundance of flame and smoke, but leaving more residuum behind than either naphtha or petroleum: it is also heavier than those oils, though still light enough to float on water. From this description it will readily be seen that maltha is a mere variety of the other two bitumens, scarcely deserving of another name. From their great resemblance to each other, it is not at all surprising that they should frequently be confounded, since they are often met with in the same spot, and are used for similar purposes.

This kind of bitumen, however, is more particularly found near Clermont, in the department of Puy-de-Dôme, in a place called *Puy de la Pège*, where it covers the ground with a viscous varnish, that adheres with great tenacity to the traveller's feet. Maltha is also found in Persia, in the route from Schiras to Bender-Congo. It is found in a mountain called Darap, where it is carefully collected, and carried to the king of Persia, as a sovereign balsam for the cure of wounds.

Maltha resembles soft pitch, and is used for the same purposes, such as paying the sides of boats, &c.

Asphaltum is a similar bitumen in a more condensed state; solid, dry, and so friable as to be pulverised with the greatest ease. It is often perfectly black and opaque, and smells very strong when it is either heated or rubbed; in the last case it becomes electric. Small and very thin pieces are semitransparent, and when looked through appear of a red colour.

The surface of the lake of Judea yields a great quantity of this bitumen, and from thence has obtained the name of the Lake of Asphaltes. The asphaltum brought by the springs of this lake is driven by the wind to the shore, where it hardens, and is collected by the neighbouring inhabitants for commercial purposes. From the disagreeable smell that this bitumen exhales, travellers have gone so far as to say that birds flying over the lake are suffocated, and that from this circumstance the lake with many has been called the Dead Sea. There is also a lake of asphaltum in the island of Trinidad in the West Indies, which was visited by Mr. Tobin in the year 1801; from whose account we learn, that the lake is situated about a mile from the gulf, on an eminence of from eighty to a hundred feet above the level of the sea. It is about a mile across, intersected every where by streams of pure clear water, which abound with small fish. In many places even in the centre of the lake, on the solid pitch, are said to be spots having the appearance of so many islands, on which grow plants and shrubs of various kinds. The water of the streams is of various depths, from two to ten feet, and the channels are continually fluctuating; one of eight or ten feet to-day, may to-morrow be entirely closed up, and others formed where yesterday was a solid mass of pitch. From this Mr. Tobin thinks it evident that the asphaltum itself is supported by a lake of water underneath, but he is unable to form any idea of the thickness or substance of the stratum of bitumen.

Asphaltum and maltha were both used by the Egyptians, mixed with the resin of the cedar, in embalming their dead bodies; and it is observed, that the mummies are strongly impregnated with these materials even to the centre of the bones.

There is still another kind of bitumen which may be mentioned in this place, though very different in some of its properties from those we have already mentioned. Magellan calls it elastic petrol, Kirwan mineral caoutchouc, and Brogniart elastic bitumen. The properties which it possesses, in common with other bitumens, are its strong smell, particularly when soft; its tendency to inflammability, and its being light enough to swim on water; but it differs essentially in its texture, and is so elastic that it can hardly be distinguished from Indian rubber, having the same property of removing the traces of a black lead pencil from paper. It is found in the same places as petroleum, that is, among spars and lead ores, either in lumps, or in a cylindrical form, like bits of thin branches or stalks of vegetables.

This very singular fossil was first discovered in the year 1785, near Castleton in Derbyshire, in the fissures of slate, but in very inconsiderable quantities. In colour and consistency it exactly resembles the gum-resin brought from Brazil, and known by the name of caoutchouc or Indian rubber.

# COAL.

SPECIFIC CHARACTER.

| | |
|---|---|
| Bitumen Lithanthrax. | B. opacum nigrum fragile cum flamma ardens et ardendo fumum nigrum eructans. *Linn. Syst. Nat. Gmel.* 3. p. 281. |
| | Black, opake, and brittle; burns with a flame, and throws off a black smoke. |
| | Bitumen lapideum shisto vel aliis terris mixtum et induratum. *Waller. Syst. Miner.* 2. p. 98. no. 6. |
| | Pix montana dura rudis fragilis. *Wolters. Miner.* 25. |
| Common Coal. . . . | *Cronst. Miner.* 2. p. 476. *Patrin, Hist. des Miner.* 5. p. 315. *Brogn. Miner.* 2. p. 2. |

Coal, of all the substances which naturalists have arranged in the class of inflammables, is by far the most serviceable to mankind. Nature has dealt it to us with an unsparing hand, and has provided mines of this mineral which seem to defy the power of man to exhaust. England and France, where the different branches of manufacture are carried to a greater extent and perfection than in the other countries of Europe, are, at the same time, the most abundantly provided with mines of coal, as if Nature was determined to second the exertions of an industrious people by giving them the best possible assistance.

The form and uses of coal are too well known to require any description; we shall therefore confine ourselves to an account of its disposition in the bowels of the earth, and to some of the principal collieries in different parts of Europe.

Coal is always found in masses, sometimes in a heap, most frequently in beds; but rarely in veins. The beds are disposed within the earth with different degrees of inclination, and in almost every possible direction. These beds of coal are supposed by most naturalists to be a deposit formed by the waters of the ocean, which once covered our continent. They are never found single, but generally disposed in strata one above another. The beds of coal are separated by layers of stone, which are nearly of the same nature in all coal-mines. Those which form the side and the top of a stratum of coal are a sort of friable slate, containing more or less of bitumen, while the bottom is generally more compacted and mixed with micaceous sand. It is remarkable that this slaty kind of stone, which so generally accompanies the coal, should frequently contain the impressions of plants, and particularly ferns, some of which are met with in the finest state of preservation.

Patrin informs us that the coal-mines in France are generally surrounded by primitive rocks, especially the rich mines of Forez and Auvergne; but it must also be remarked, that we find them absolutely enclosed in earths of a secondary formation, such as those of Flanders and the mines of our own country. A circumstance mentioned by Patrin, which deserves to be attended to, is this: the beds of coal in these mines are always separated from each other by free stone and slate, sometimes of an enormous thickness, although it often happens that nothing is to be found in the neighbouring earth which can contribute to the formation of these stony layers. This almost amounts to a demonstration that they are immediately produced by a chemical combination of nature, and not by any accumulation of pre-existent materials.

Layers of lime-stone also occur between beds of coal, but always (I believe we may say without exception) they are lined both at top and bottom with slate. All the calcareous ridge on the French side of the Alps contains beds of coal enclosed in the chalk, sometimes mixed with shells. A great number of these beds have been discovered, and several worked from Lower Provence to the mountains of Meillerie, on the lake of Geneva. Several, and especially those of the intermediate countries, are noted for their extraordinary elevation above the surface of the sea. Those of Provence occupy a space of ten leagues in length from the south-east to the north-west, from Nans to Gardonne, near Aix. They are at the foot of great mountains, in hills composed of alternate layers of chalk and clay;

in the former of these run the beds of coal of two or three feet thick ; but it is remarked that none of the layers of clay contain any of this mineral.

Among the mines of coal which are remarkable for their local elevation, may be mentioned that of Saint-Oulx, a town of Piedmont. According to the barometrical measurement of Dr. Guerin, it is 180 fathoms above the surface of the sea. Although this mine may be rich, it has been worked only two years, on account of its almost inaccessible elevation. This height, however, is comparatively nothing to that in which Leblond observed layers of coal in Peru. He tells us that he found beds of this substance in the Andes, near Santa-Fe-de-Bogota, which were situated two thousand two hundred fathoms above the ocean.

In *Scotland* the mines of Carron, of Edinburgh, and of Glasgow, are chiefly distinguished for their produce. There are three beds of coal at Carron, the first of which is about 40 fathoms below the surface, the second 50, and the third 55. Only two beds are worked at Edinburgh, and one of them is remarkable for its situation, the opening of the mine being hardly forty fathoms from the sea, and only three fathoms above high-water mark. The mines of Glasgow stretch from the north-east to the south-west, and occupy a considerable space of ground. Here are several beds of coal, placed on each other, and continued nearly from the surface of the ground to the depth of three hundred feet; but of these beds there are only two or three that are worth the trouble of working.

The principal mines of this useful mineral in *England* are those of Newcastle and Whitehaven. The town of Newcastle absolutely stands on beds of coal, which extend to a considerable distance round the place. There are seven or eight beds of this mineral, one above the other, and all inclined in a south-east direction; the lowest is a hundred fathoms from the surface of the earth. But the mines near Whitehaven, which have been described by Nicholson and Burn, in the History of Cumberland, will afford the best idea of these wonderful places. We learn from this account, that "these coal-mines are, perhaps, the most extraordinary of any in the known world. The principal entrance for men and horses is by an opening at the bottom of a hill, through a long passage hewn in the rock; which, by a steep descent, leads down to the lowest vein of coal. The greatest part of this descent is through spacious galleries, which continually intersect each other; all the coal being cut away, except large pillars, which, in deep parts of the mine, are three yards high, and twelve square at the base. The mines are sunk to the depth of a hundred and thirty fathoms, and are extended under the sea to places where, above them, the water is of sufficient depth for ships of large burthen. These are the deepest coal-mines that have hitherto been wrought; and perhaps the miners have not in any other part of the globe penetrated to so great a depth below the surface of the sea; the very deep mines in Hungary, Peru, and elsewhere, being situated in mountainous countries, where the surface of the earth is elevated to a great height above the level of the ocean.

"There are here three strata of coal, which lie at a considerable distance, one above another; the communication between each is preserved by pits. The vein is not always regularly continued in the same inclined plane, but is sometimes interrupted by hard rock; and in those places the earth seems to have sunk downwards from the surface, while the part adjoining hath retained its antient situation. These breaks the miners call *dykes*; and when they meet with one of them, they first observe whether the direction of the strata is higher or lower than in the part where they have been working. If, to employ their own terms, it is *cast down*, they sink a pit to it with little trouble; but should it, on the contrary, be *cast up* to any considerable height, they are frequently obliged to carry a long level through the rock with much expense and difficulty, till they again arrive at the vein of coal.

"In these deep and extensive works, the greatest care is requisite to keep them continually ventilated with perpetual currents of fresh air, to expel the damps and other noxious exhalations, and supply the miners with a sufficiency of that vital fluid. In the deserted works, large quantities of these damps are frequently collected, and often remain for a long time without doing any mischief; but when, by some accident, they are set on fire, they produce dreadful and destructive explosions, and burst out of the pits with great impetuosity, like the fiery eruptions from burning mountains.

" The coal in these mines hath several times been set on fire by the fulminating damp, and continued burning many months, until large streams of water were conducted into the mines, and suffered to fill those parts where the coal was on fire. Several collieries have been entirely destroyed by such fires: of these there are instances near Newcastle, and in other parts of England, and in the shire of Fife in Scotland; in some of which places the fire has continued burning for ages. To prevent as much as possible the collieries from being filled with these pernicious damps, it has been found necessary to search for those crevices in the coal whence they issue, and then confine them within a narrow space, from which they are afterwards conducted through long tubes into the open air, where, being set on fire, they consume in perpetual flames, as they continually arise out of the earth. The late Mr. Spedding, who was the great engineer of those works, having observed that the fulminating damp could only be kindled by flame, and was not liable to be set on fire by red-hot iron, nor by the sparks produced by the collision of flint and steel, invented a machine, in which, while a steel wheel is turned round with a very rapid motion, flints are applied to it, and by the abundance of fiery sparks emitted, the miners are enabled to carry on their work in places where the flame of a lamp or candle would occasion dreadful explosions. Without some invention of this sort, the working of these mines would long ago have been impracticable, so greatly are they annoyed by these inflammable damps. Fewer mines, however, have been ruined by fire than by inundations; and here that noble piece of mechanism the steam-engine displays its beneficial effects. When the four engines belonging to this colliery are all at work, they discharge 1228 gallons of water every minute, at thirteen strokes; and, after the same rate, 1,768,320 gallons every twenty-four hours."

The road from the Whitehaven coal-mines to the water-side is mostly on a gentle descent, and provided with an iron rail-way: this, by removing much of the friction, exceedingly facilitates the carriage of the coals to the shipping, which are laid along-side of the quay to receive them. When the waggons are loaded, they run without any assistance on the rail-way till they arrive at the quay, where the bottom striking out, the waggon discharges its contents into a large fleue, or, as the workmen term it, a *hurry*, through which it rattles into the hold of the vessel with a noise like thunder. A man is placed in each waggon to guide it, who checks its progress, if necessary, by pressing down one of the wheels with a piece of wood provided for the purpose. When the waggons are unloaded they are carried round by a turn-frame, and drawn back to the pits by a single horse along another road.

The principal mines in *France* are those of Lyonois, Forez, and Saint-Etienne. The two former are situated in a valley which was formerly covered by the sea, and which extends from the Rhone to the Loire between two chains of primitive mountains. They occupy a space of six or seven leagues in length, and the coal rests upon the usual layers of stone and slate. The beds of coal near St. Etienne are placed in the earth almost in a horizontal direction, and are generally from three to six feet thick. The layers of slate which form the upper surface of the coal in these mines are full of vegetable impressions, and the frequent occurrence of this phænomenon has been a strong reason with many for supposing that coal owes its origin to decayed vegetable matter.

There are several hills in the neighbourhood of St. Etienne where the mines have been on fire, and there are some, according to Patrin, where the fire yet subsists. It has been so violent, says this mineralogist, that we meet with enormous masses of slate which have been almost entirely converted into scoria.

The coal-mine in the neighbourhood of Liege is the most productive of any in *Germany*. It occupies a space of two miles, and consists of more than forty beds of coal, placed one above another, and separated by strata of stone from thirty to a hundred feet in thickness. These layers of coal are situated at a place called Vert-Bois, to the north-west of the city; and it has been remarked that the beds incline to the south, while those of a neighbouring mountain (to the south-east of Liege) dip to the north. Naturalists suppose these to be part of the same layers, which, passing under the large valley that separates this mountain from Vert-Bois, rise again on the opposite side, and thus take the form of a boat.

There are different opinions among geologists respecting the origin of coal. Some suppose this combustible substance to be produced by the decomposition of the soft parts of the immense quantity of organized bodies, of which we find almost every where the solid remains. But unfortunately this conjecture, which appears so natural, is liable to several strong objections. One, is the presence of vegetables, scarcely decomposed, which are often met with in the middle of beds of coal. The others, the want of direct experiments to prove that organized bodies give out bitumen during their decomposition. Without stopping to discuss these points, we shall merely give the general conclusions of naturalists as they are mentioned by Brogniart:

1. That coal was formed either at the same time, or after the existence of organized bodies.

2. That this mineral, when first formed, was liquid, and of a great degree of purity.

3. That the cause which produces this deposit is

several times renewed in the same place, and nearly under the same circumstances.

4. That the cause, whatever it may be, is nearly the same over all the earth; since the beds of coal always exhibit nearly the same phænomena in their structure and accidental circumstances.

5. That these beds have not been deposited by any violent revolution; but, on the contrary, in the most tranquil manner; since the organized bodies that are found in them are often entire, and the leaves of vegetables impressed in the slate which covers the coals are hardly ever bruised, or otherwise deranged.

# BLACK LEAD.

GENERIC CHARACTER.

Opaque.

Of a dark metallic lustre, leaving a strong mark on paper.

Very brittle, breaking into fragments of no determinate figure.

SPECIFIC CHARACTER.

| | |
|---|---|
| GRAPHITES PLUMBAGO. | G. nitoris metallici, texturæ schistosæ. *Linn. Syst. Nat. Gmel.* 3. p. 284. |
| | Of a metallic lustre and slaty fracture. |
| | Molybdænum tritura cærulescente impalpabile at subsquamosum. *Syst. Nat. Linn.* xii. 3. p. 121. no 1. $\alpha$ $\beta$. |
| | Ferrrum nigricans splendens, unctuosum inguinans. *Woltersd. Miner.* 31. |
| | Ferrum corrosum volatile mineralisatum, minera nigrescente squamosa pictoria magneti refractaria. *Waller. Syst. Miner.* 2. p. 249. no. 14. |
| BLACK LEAD. . . . . | *Cronst. Miner.* 2. p. 451. *Kirwan, Miner.* 2. p. 58. *Brogn. Miner.* 2. p. 53. |

THIS useful mineral is found to be of an inflammable nature, and therefore is placed among other combustible substances. It is well known for the fine blackish trace which it leaves when rubbed on paper, and which renders it of such essential service to the artist; especially as its marks can be entirely removed with a piece of the elastic resin known by the name of Indian rubber*.

According to Brogniart, black lead appears to be entirely confined to the primitive earths. He says that it sometimes enters into the composition of the rocks which form these earths, sometimes it is found in lumps or in beds of a considerable thickness, and it is also met with in layers of argillaceous slate. In the department of Arriege, in *France*, it is found in large compact masses. It occurs likewise in the department of Mont Blanc; in that of La Sture, near Vinay; and in the mountain of Lubacco, where little veins of it are found in granite. In *Spain* it occurs in the mountains of Arragon, and near Casalla, and Ronda in the kingdom of Grenada; but none of these places are to be compared with Borrowdale, in *England*, for the production of black lead. This valley, which is situated in the south-east part of Cumberland, about four miles from Keswick, is enclosed by rude and lofty hills, in one of which the black lead is found in sufficient abundance to supply almost all the world. The mines are said to lie to the east of a very steep mountain, which forms the west side of the vale of Stomathwaite. There are two workings; the lower one is about three hundred and forty yards above the level of the sea, and its perpendicular depth about 105 yards; the upper one is nearly 390 yards

* See Syringe Tree.

above the sea, and its depth about thirty. The strata of the mountain are very irregular and broken, and the black lead appears to have been found in the fissures. The mineral is described as lying in the mine in form resembling a tree, having a body or root, and veins, or branches, spreading from it in different directions: the root, or body, is the finest black lead; the branches, the worst; and even these decrease in quality in proportion as they are distant from the main trunk. The black lead is generally imbedded in a blue rock, which is often stained as black as the mineral itself to the depth of two or three feet. In the deepest mine the black lead lies in two veins, which cross each other, and the richest lead is said to be at the point of intersection. These veins fall perpendicularly to the depth of forty fathoms.

Tradition says that we owe the discovery of this valuable mine to a storm, which blew down a large oak, whose roots, tearing up several fragments of the rock where it had grown, discovered the lead. For some time after the mineral was found it was only used to mark sheep; but as its properties became better known its value increased, and the price of course kept pace with the demand; so that when Mr. Pennant visited Cumberland in the year 1772, the best kind might be obtained for twelve shillings a pound, which now sells for sixty. The mines are opened at intervals for a certain period, and then closed up again. Formerly this was only permitted to be done every seven years; but it is said that they are now opened more frequently, and that the persons employed are watched very narrowly to prevent their stealing the mineral.

Some years ago, says Magellan, this mine appeared to be almost exhausted; but by digging a few yards through the strata underneath, according to the advice of an experienced miner, whose opinion had been long unattended to, the workmen discovered a very thick and rich vein of black lead, to the great joy of the proprietors and advantage of the public. The lead from this mine is acknowledged to be the best in Europe; Magellan having seen various specimens from different countries, but none of them were either of a texture or quality to compare with the lead of Borrowdale.

The lead is prepared for pencils by being cut into a proper shape, and placed in quadrangular grooves made of cypress wood, over which a slip of the same is placed, and the wood worked into small cylinders like quills. But the use of black lead is not confined to the manufactory of pencils; it is of great service to chemists, either in the shape of crucibles, or mixed with different ingredients for covering the retorts and other vessels which are intended to resist a strong fire. Fourcroy considers its power to prevent iron from rusting as one of its most important properties. The pipes of stoves, the back parts of grates, and other utensils exposed to the action of fire and air, are coated with powder of black lead to preserve them from rusting, which is applied to their surface by simply rubbing with a brush. One of the useful applications of this powder is to smooth the surfaces of wood-work which slide one over the other, such as wooden screws, &c. and it is said that the black lead produces a better effect on them than either greasy or oily substances.

From this mineral containing about a tenth of its weight of iron, some naturalists have placed it among the iron ores; nevertheless it must belong more properly to the class of inflammables, since it has been observed to burn away almost entirely when exposed to an intense heat in an open vessel.

# AMBER.

GENERIC CHARACTER.

Smooth and shining.
Fracture conchoidal; becomes electric by friction, and emits an agreeable smell.
Burns with a greenish or blueish flame.

SPECIFIC CHARACTER.

| | |
|---|---|
| Succinum electricum. | Succinum. *Linn. Syst. Nat. Gmel.* 3. p. 282. |
| | Electrum, diaphanum, solidum. |
| | Solid diaphanous amber. |
| | Bitumen solidum durum, nitidum. Suaveolens. *Cartheus. Miner.* 48. |
| | Succinum pellucidum et opacum. *Waller. Miner.* 200. 201. |
| Amber. . . . . . . | *Cronst. Miner.* 2. p. 460. *Kirwan, Miner.* 2. p. 65. *Patrin, Hist. des Miner.* 5. p. 346. *Brogn. Miner.* 2. p. 49. |

The colour of amber varies from a very pale yellow to a deep red: it likewise differs in its degrees of transparency, some being found opaque, while other specimens are very pellucid. It is generally of a compact texture, and hard enough to receive a polish; on which account it is used among other articles of jewellery, and is particularly prized when it contains any insect or vegetable within its substance. It has been long known for its electrical property, being very easily excited by friction so as to attract small pieces of paper and other light bodies.

Amber is found, but not in any great quantity, in several parts of Europe: the principal place where they collect this combustible mineral, is in Eastern Prussia, on the shores of the Baltic between Konigsberg and Memel, on which it is supposed to be thrown by the waves. In this country it is found also at the depth of about a hundred feet, reposing on wood-coal in lumps of from half an ounce to four or five pounds. Several parts of the Mediterranean yield this substance, especially the coast of Genoa, and the eastern coast of Sicily.

The amber which is found within the bowels of the earth is not confined to Prussia, but is likewise met with in Lithuania, in Poland, and in Italy. It ought to be remarked that it generally occurs in a blackish sand, among fossil or bituminous wood; and we may reasonably suppose that it was at one time in a fluid or at least a soft state, since among the pieces collected we frequently meet with some that contain the remains of organized bodies. These are chiefly of the insect tribe, and the specimens containing them are so valuable that many have been tempted to deceive the public by introducing flies and other insects artificially, and this is often so cleverly managed that it is almost impossible to detect the fraud.

Amber is rarely found in large pieces: that in the cabinet of the king of Prussia is reckoned of an extraordinary size, being a foot in diameter, and of a lenticular shape. We are told indeed of a column of amber six feet high in the gallery of Florence, but that must certainly have been formed of many pieces cemented together. Among the specimens of this mineral deserving of notice, may be mentioned those in the hall of the chateau of Tzarsco-Celo, near Petersburg, where the wainscot was disposed in compartments formed entirely of plates of amber of seven or eight inches long. This rich decoration was a present from the king of Prussia. When Patrin was at Grodno in the year 1777, his friend Gilibert, who was then director of the Academy, showed him an old Spanish rosary, of amber, with an insect in every bead. Brydone, in his Travels in Sicily, says, that in the mouth of the Giaretta (the antient Simethus), which falls into the sea near Catana, the people find a considerable quantity of very fine amber, which they carry to Catana, where it is worked into crosses, rosaries, &c. Several of the pieces, according to this traveller, are full of flies and other insects. He tells us that the amber from this place is by far more electric, and of a much stronger smell, than that from the Baltic.

The origin of amber has always been involved in obscurity, and many uncertain opinions have been hazarded to account for it. Some suppose it to be a bituminous juice which exudes from the earth, and afterwards assumes the consistence in which we find it; others, that it is not a mineral but a vegetable substance, which formerly trickled from the trunk of some resinous tree and became afterwards condensed into a solid form. This conjecture carries with it a great appearance of probability, as it readily accounts for the insects which we find within the amber, and which may have been entangled in the juice while in a fluid state.

The antient mythologists account for the origin of this singular substance without any difficulty. They tell us that when Phaëton, for his rash and presumptuous conduct, was precipitated from heaven on the banks of the Po, his sisters bewailed his death so bitterly, that the gods, out of compassion for their sorrow, changed them into poplars: these poplars still retained all the sensibility of their representatives; they continually wept, but their tears were drops of amber.

# GOLD.

GENERIC CHARACTER.

Colour yellow.
Soluble only in aqua regia.
Melts at 32 degrees of Wedgwood's pyrometer; but remains unaltered in the strongest fire.

SPECIFIC CHARACTER.

| | |
|---|---|
| Aurum nativum. | A. nudum ponderosissimum ductile, visibile matrici adhærens. *Linn. Syst. Nat. Gmel.* 3. p. 378. |
| | A naked, heavy, ductile metal, visibly adhering to a matrix. |
| | Aurum nativum genuini coloris. *Cartheus. Miner.* 77. |
| | Aurum nativum radicatum. *Waller. Miner.* 321. |
| Native Gold. . | *Cronst. Miner.* 2. p. 520. *Kirwan, Miner.* 2. p. 93. *Patrin, Hist. des Miner.* 5. p. 158. *Brogn. Miner.* 2. p. 264. |

This precious metal appears under various forms, and in different situations in the earth. It is occasionally found in solid masses, as in Hungary, Peru, and Transylvania: in a granular form, as in the

West Indies; in a vegetable shape, like branches or twigs of plants; composed of thin plates covering other bodies, as in Siberia; or in octaëdral or eight-sided crystals, as in some mines in Hungary.

The name of native gold is given to this mineral when it appears in the mines under a metallic form so as to be readily known. The largest specimen of native gold which has been as yet found in Europe, was discovered some years ago in the county of Wicklow in Ireland: it is said to have weighed twenty-two ounces. Several other pieces exceeding an ounce were found at the same place, in sand covered with turf, near a rivulet.

Native gold is scarcely ever found in a state of perfect purity. That which approaches nearest to perfection is of a fine yellow colour, but in general it is more or less alloyed with silver, copper, iron, or platina; in consequence of which it becomes either of a brassy colour, or of a greenish- or gray-yellow. It frequently happens, however, that gold is not apparent in its native state, but concealed in small quantities in other minerals, from whence it is extracted by art whenever the quantity is supposed to be sufficient to pay for the trouble and expense of obtaining it.

The sulphureous metals and other minerals which contain gold, scarcely exhibit a single character that indicates its presence. It has been remarked that the sulphures of iron which contain the most are of a bright yellow colour; but this character is not to be depended upon, and is often, perhaps, without foundation.

Mines of gold are very rare in the northern or even in the temperate climates. One only has been discovered in France, which is situated in the valley of Oisans in Dauphiny. This has been known since the year 1781, and some pretty specimens of gold have been obtained from it; but they are chiefly preserved in cabinets, as the vein in general is too poor to pay the expense of working. Gold-dust has been found, however, mixed with the sand at the bottom of several rivers on the continent. The Rhine between Strasburg and Philipsburg; the Rhone in Franche Comté; the Gège and the Gardon, in the Cevennes; the Arriege near Pamiers; the Garonne near Toulouse; and the Salat near Saint-Girons in the Pyrenees, have all been mentioned as producing this precious mineral in small quantities.

Most great rivers contain gold amongst their sands, even those which do not rise in countries where gold-mines exist;—therefore we may readily suppose that the rivers which pass near mines of this metal must occasionally wash away some of their riches. Thus the river Avanyos in Transylvania is said to afford subsistence to seven hundred gipsy families, who collect the gold from its bed. In Brasil, the gold is found in such great abundance, that the torrents are often diverted into new channels, with great labour and expense, in order to collect the gold deposited by the stream.

A gold-mine was discovered in the reign of Peter the Great in the mountains of granite which skirt the eastern side of the lake Ladoga near Alonetz. When first this mine was worked, the vein containing the metal was supposed to be inexhaustible. Masses of native gold of a pound and more in weight were found near the surface of the earth, but after digging several fathoms, these flattering appearances vanished all at once, and left the workmen nothing but a barren vein of quartz. Several specimens of gold from this mine, as rich as those brought from Peru, are preserved in the cabinet of mineralogy of the Academy of Sciences at Petersburg.

Several parts of *Asia* contain gold-mines of considerable importance, especially the southern countries of this extensive quarter of the world. Among the rivers and rivulets which produce this metal may be mentioned the Pactolus, a little river of Lydia, in which tradition tells us, that Midas washed himself when he turned into gold whatever he touched, and that Crœsus afterwards derived all his riches from the same place. One would suppose from the present state of this celebrated river, that the covetous monarch left very little for posterity.

China and Japan are rich in gold-mines; and the kingdom of Siam is, perhaps, of all the countries in Asia, the most productive in this metal; at least if we may judge by appearances,—since the king's domestic utensils, as well as the troughs for his white elephant, and most of the ornaments of the temples, are of solid gold.

In the *African* continent gold seems to be very abundant. Tavernier tells us that in the country of Sofala, of Mosambique, and of Monomotapa, on the eastern coast of Africa, gold is found in dry places, scattered in the earth at the depth of two or three feet from the surface.

The gold from Africa, which is so abundantly spread in commerce, is all in the form of dust; from whence Brogniart conjectures, that the greatest part is collected from the earth which has been left by the rivers. The negroes frequently carry this precious dust in the quills of ostriches or vultures. The country of Bambouk furnishes a considerable quantity of gold, which is sold on the western coast of Africa, from the mouth of the river Senegal to Cape Palmas. It is mostly found in spangles, near the surface of the earth, or in the beds of rivulets, from whence it is separated by repeatedly washing the sand. The principal part of the gold which is carried to Morocco, to Fez, and to Algiers, by the caravans from Tombuctoo, which cross the great desert of Zahara, is also found in the same country.

But *America* is the quarter of the world where gold seems to have been spread with the greatest profusion. It is chiefly found in spangles, though it likewise occurs in veins mixed with other metals.

South America, especially Brasil and Chili, are the countries which produce the most; we must not, however, omit Mexico, which is rich in veins of silver containing more or less of gold. But all those veins which are found in mountainous countries, and which are so rich in silver, contain, comparatively, but little gold. It is in the valleys and the plains, near the surface of the sandy soil, where this metal is principally disseminated, and from whence, as we have before remarked, it is separated by repeated washings. Indeed there appears to be scarcely any part of the torrid zone where the earth is of a sandy and ferruginous nature, that does not contain gold in a greater or less proportion.

Gold is a metal in which are united the most useful properties, without any prejudicial mixture: it has ever been regarded as the most perfect and the most precious of all the metallic substances, and has consequently been sought after in all ages, and by every nation. Ductile and malleable in a supreme degree, it takes, with ease, every form that can be given it by the art of man. It is susceptible of the most beautiful polish, and its colour, which is as engaging as it is unalterable, makes it, of all other metals, the most proper for ornaments.

As a proof of its great ductility, an ounce of this metal may be formed into a thread of seventy-three leagues in length, and the same quantity may be beaten into sixteen hundred leaves, of nine square inches each. This great ductility, however, is very much impaired when the smallest quantity of arsenic or tin is mixed with the gold, a single grain of these metals being sufficient to alter a whole ingot.

Gold has neither smell nor taste; it is neither attacked by air, water, or even by fire, Boyle and Kunckel having exposed it during several weeks to a violent heat, without its having lost a single grain. It is true that when exposed to the focus of a large burning lens, it is evaporated, but without changing its metallic state. This evaporation was proved by exposing a plate of silver to the fumes of the melted gold, which was soon found to be perfectly gilt. The operation, however, cannot be effected without the assistance of a most powerful burning glass, such as that belonging to Mr. Parker in Fleet-street, which is three feet in diameter.

This valuable metal is not soluble in either of the mineral acids taken separately; but when the nitrous and marine acids are united, they form a menstruum that dissolves gold, and which from thence has obtained the name of aqua regia. If a solution of gold in this liquor be properly mixed with tin dissolved in the same menstruum, a fine purple powder is precipitated, (called by the name of *Cassius*, its inventor,) which produces a beautiful lasting purple colour. This powder, when mixed with vitreous substances, is used in preference to all others by the painters in enamel and glass manufacturers.

If volatile alkali be added to the same solution of gold in aqua regia, a reddish yellow powder is precipitated, which is called *aurum fulminans*. A few grains of this powder explodes with a prodigious noise when exposed in a metallic spoon or plate, over a candle, coals, or a red-hot iron; or when by other means it is sufficiently heated, the powder detonates with a crash sixty-four times greater than an equal quantity of gunpowder. A moderate degree of heat is sufficient to produce this amazing explosion, by which the most violent effects are produced. Ten or twelve grains exploded on a metal plate, perforated it completely; and a few ounces having accidentally exploded together, shattered the doors and windows of the apartment where it was drying. Even simple trituration, or percussion alone, is enough to cause this powder to explode with all its violence. A melancholy instance of this is related by Macquer, of a young man of his acquaintance, two-and-twenty years old, who, in closing a small phial of this powder, kindled a little by the friction of the glass stopple: the bottle instantly burst into pieces; and the concussion was so great that he was struck to the ground, and totally lost his sight.

# PLATINA.

### GENERIC CHARACTER.

Colour white, between tin and silver.
Soluble only in aqua regia.
Malleable and ductile as gold.
Infusible in the fire of a furnace, but yielding to the heat of a powerful burning glass.

### SPECIFIC CHARACTER.

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|---|---|
| Platina granulata. | Platina. *Linn. Syst. Nat. Gmel.* 3. p. 383. |
| | Platina del Pinto. *Waller. Syst. Miner.* 2. p. 365. no. 7. |
| | Platine natif ferrifère. *Haüy.* |
| Platina. . . . . | *Cronst. Miner.* 2. p. 567. *Kirwan,* 2. p. 103. *Patrin, Hist. des Miner.* 4. p. 323. *Brogn. Miner.* 2. p. 275. |

This singular metal, which we have scarcely known for more than half a century, is brought to us from Peru in a granular state. It is of a whitish iron-gray colour, is mixed with quartz and ferruginous sand in different proportions, and often contains particles of gold or quicksilver. In a state of purity it is the heaviest of all metals, its specific gravity being greater than that of gold. It is so refractory in the fire, that the greatest degree of heat which can possibly be obtained with the assistance of oxygen gas is scarcely sufficient to melt it; though the solar rays, when concentrated by the most powerful means, fuse it in less than two minutes. What we have here said must be understood of pure platina; for when mixed with other metals and semi-metals, especially with arsenic, it melts very easily.

Don Antonio de Ulloa, who, in concert with the French astronomers, was sent to Peru in order to measure a degree of the meridian at the equator, is the first person who has mentioned platina. It appears, however, from the manner in which he has spoken of it, that he never saw the metal, since he describes it as " a *stone* of such resistance, that it is not easily broken by a blow upon an anvil. It is not subdued by calcination; and it is very difficult to extract the metal it contains, even with much labour and expense."

As platina is capable of receiving a very high polish, not so subject to tarnish as mixed metals, nor, like glass, to give a double image, the French government have consigned a quantity to the members of the Institute, for the purpose of constructing a telescope of such a magnitude and excellence, as (they hope) shall exceed the best of Dr. Herschel's.

One of the properties which renders this metal of great utility to practical mathematicians, is the power with which it resists the variations of the atmosphere: most other metals sensibly contract in cold weather and dilate when it is warm; but platina is so little changed by different temperatures, that it has lately been made into rules, and applied by the geometricians Delambre and Mechain, when they measured a degree of the meridian in France. It is also of the first importance to philosophical chemists, when made into crucibles, &c., on account of its great infusibility.

It appears from the account which Leblond has published in the *Journal de Physique* for November 1785, that platina is found only at Novita and Citara, in the province of Choco in South America. This province is situated in a deep and extensive valley, inclosed by the Andes; from which circumstance Leblond supposed that gold and platina were originally formed within these mountains, and that these metals, which are at present found in the valley, have been washed down from them in some of their decayed earth. "It is rare in Choco," says this naturalist, "to meet with sandy earth without some particles of gold amongst it; but it is only in the two districts of Citara and Novita that we find it *always* mixed with platina."

Platina is always found in the form of very small particles, from the size of the smallest sand to that of a common pea; the particles are detached from the earth with which they are mixed, with great care, being spread on a polished plate, and separated, grain by grain, with the blade of a knife.

As the platina is generally more or less mixed with gold, they form this last metal into an amalgam, by uniting it with quicksilver, which is afterwards separated from the gold by heat. This operation occasions those little globules of mercury to appear which are sometimes found with platina.

# SILVER.

GENERIC CHARACTER.

Colour pure white.

Soluble in the three mineral acids; most in the nitrous acid, least in the marine.

Less malleable and ductile than gold.

Melts at 28 degrees of Wedgwood's pyrometer.

SPECIFIC CHARACTER.

ARGENTUM NATIVUM. A. malleabile ductile intus metallice nitens, aqua forti totum solvendum. *Linn. Syst. Nat. Gmel.* 3. p. 356.

Malleable, ductile, and of a metallic lustre within; entirely soluble in aquafortis.

ARGENTUM NATIVUM. *Waller. Miner.* 307. *Syst. Miner.* 2. p. 328. no. 1.

Argentum nudum malleabile. *Carth. Miner.* 75.

NATIVE SILVER. . . *Cronst. Miner.* 2. p. 540. *Kirwan, Miner.* 2. p. 108. *Patrin, Hist. Nat. des Miner.* 5. p. 128. *Brogniart, Miner.* 2. p. 248.

NATIVE silver is generally found in irregular shapes; sometimes in masses of no determinate form, sometimes branched, occasionally in capillary filaments, and not uncommonly in leaves. Thus it appears in most mines, and particularly in those of Siberia, where Patrin tells us he never met with it crystallized. It is found in the mines of Peru in a vegetable form, imitating the leaves of fern. This pretty variety of figure in native silver is occasioned by a vast number of little eight-sided crystals, so disposed upon each other as to give the whole the appearance of a vegetable. The curved cylindrical filaments, in which form silver is sometimes found, are of various sizes, from the thickness of a finger to the diminutive size of a hair. It is very rare to find it in separate cubical or octaëdral crystals. Romé de l'Isle speaks of a specimen in which the crystals where as large as a filberd, having the form of a cube, of which the eight solid angles were truncated. This piece came from the mines of Konigsberg in Norway, and was imbedded in white calcareous spar.

Native silver is seldom found pure, but is generally mixed with other metals; such as gold, copper, mercury, iron, lead, &c. This last metal almost always contains a portion of silver, though frequently so small as not to be worth the expense of separating it. In the reign of Edward the First near 1600 pounds weight of silver were obtained, in the course of three years, from a mine in Devonshire, which had been discovered about the year 900. The lead-mines in Cardiganshire have, at different periods, afforded great quantities of silver.

Sir Hugh Middleton is said to have cleared from them 2000 pounds in a month. The same mines yielded, about the year 1745, eighty ounces of silver out of every ton of lead. The lead ores from Brunghill and Skekorn produced also a considerable quantity of silver. The lead only, in one of the smelting-houses at Holywell in Flintshire, produced no less than 31,521 ounces, or 3126$\frac{3}{4}$ pounds of silver, from the year 1754 to 1776. "There are some lead-ores in this country," says Dr. Watson, "which, though very poor in lead, contain between three and four hundred ounces of silver in a ton of that metal. It is commonly observed, that the poorest lead-ores yield the most silver, so that a large quantity of silver is probably thrown away in England, from not having the poorest sort of lead-ores properly assayed."

Besides the native silver, which is found in a metallic state, there are several combinations of this metal with different substances, such as sulphur, arsenic, &c. When mineralized by the former substance alone, it forms the glass, or vitreous silver ore, which is subject to great variety of colour. Again, when united to both sulphur and arsenic, the mass becomes the red, or ruby-like silver ore; the colour of which varies from deep red to dark gray, in proportion as either of these substances prevails.

According to Brogniart, silver in its mineral state is chiefly found in primitive earths, especially in those which are deposited in beds, though it is not confined to these alone. It is very rarely met with in granite, but not uncommonly in the fissures of micaceous rocks, and in other places of a similar nature, but of more recent formation. In the secondary earths silver often occurs, being found in chalk, slate, &c. but almost always mineralized by sulphur or arsenic.

The *gangue*, as mineralogists call it, or the stony or earthy matter which surrounds and adheres to metals, is often formed of very different substances. Thus we find silver imbedded in quartz, jasper, petrosilex, hornstone, talc, chalk, terra ponderosa, &c.

It is a singular fact that the situations of gold- and silver-mines should often be diametrically opposite in point of temperature. Gold is common in the hottest parts of the earth, while we generally find silver-mines in the cold regions. Thus the chief parts of the world where silver is to be met with, are, Sweden, Norway, and the higher latitudes near the pole: if we find it in hot climates, it is seldom on level ground; but, on the contrary, raised to a great height towards the tops of mountains that are perpetually covered with ice and snow. It is thus situated in the alpine mountains of Europe and America; and such are the mines of Allemont in France, and those of Potosi in the Andes.

The principal silver-mine in Europe is that of Konigsberg in Norway, to the north of Christiana. This is the richest, the most important, and one of the most singular mines in this quarter of the globe. The district in which it is situated is mountainous; and the mines are divided into superior and inferior, on account of their relative position. The earth is composed of beds nearly in a vertical position, and running from north to south. Some are composed of quartz mixed with mica, of granite, and of chalk; while others are formed of whitish-gray quartz, mixed with fine blackish mica, or else consist of ferruginous rock. These beds are of very considerable thickness, and contain a great quantity of native as well as of mineralized silver. Brogniart remarks that the veins are richer in mineral, and their produce more considerable, where they traverse the beds of ferruginous rock, than in any other part.

The greatest depth of these mines is about two hundred and seventy yards, and enormous masses of native silver are said to be found within them. "The annual produce about the year 1768," says Brogniart, "was two hundred and twenty myriagrammes of silver."

The mines of France are interesting rather on account of the mineralogical substances which they produce, than from the quantity of silver they contain. The mine of Allemont, ten leagues from Grenoble, is one of the principal, and was discovered in the year 1763. It is in a very elevated situation, being no less than two thousand eight hundred yards above the level of the sea, towards the top of a mountain composed of micaceous rock.

The veins of metal were found to be much richer towards the surface than deep within the mountain, so that the working of this mine is now discontinued.

The most remarkable mine of silver in Spain is that of Guadalcanal in Andalusia, which was formerly very rich, and well known to the Romans. It is situated in the *Sierra Morena*, or black mountain, on the confines of Andalusia and Estramadura, fifteen leagues to the north of Seville, and several miles to the north-east of the famous quicksilver mine at Almaden. The mineral obtained here is the ruby silver ore.

But it is in the centre of the Andes, in situations which, though immediately exposed to the perpendicular rays of the sun, are constantly covered with snow, that Nature has most abundantly distributed this metal. In twenty degrees of southern latitude, within the torrid zone, we find the famous mountain of Potosi, situated near the source of the Rio de la Plata. This mountain is one of the most considerable in Peru; its height is immense; and it appears from the descriptions of travellers, that from top to bottom it is full of veins of silver. When these mines were first discovered in the year 1545, the veins were so rich as to be almost entirely composed of silver without any mixture. At present, however, the produce is very different, scarcely more than five drams being obtained from a hundred weight of ore; still, from the great abundance of mineral, the produce is very considerable. According to the observations of several Spanish naturalists, the mountain of Potosi alone, from the time it was first discovered in 1545, till the year 1638, that is in the space of ninety-three years, hath yielded four hundred millions of *pesos*, or ounces of silver.

Patrin says, that if we compare the sketch which Ulloa has given us of the mountain of Potosi, with the description of that of Chalanches, drawn up by the learned inspector of mines, M. Schreber, we shall see, if not in riches, at least in the physical composition of the two mountains, several traits of resemblance.

That of Chalanches, like its fellow in Peru, is an alpine mountain of very considerable height, being one of the principal summits of the chain which stretches to the east of Grenoble. Its sides are very steep, and it rises fourteen hundred perpendicular fathoms above the level of the sea. All the upper part of the mountain is hid in snow, and veins of ore appear in every direction and on all sides, from the base as far towards the summit as can be traced, but the quantity of silver is but trifling.

Among the mines of the new world, those of Mexico must not be forgotten; they were discovered after those of Peru, and are now more productive. One of the principal among them is the mine of Valenciana, in the district of Guanaxuoto. The vein of mineral, which is of a very considerable size, traverses a slaty mountain, and encloses within its stony bed a great quantity of native and mineralized silver, besides a little gold. According to Brongniart, the annual produce of silver and gold amounts to about 12,500,000 francs. The mine is said to be 600 yards deep, and there still remains a vein untouched, which is supposed to contain alone as much silver as all the other mines of New Spain.

Silver possesses all the metallic properties of other perfect metals, and is fixed and unalterable in the fire of our ordinary furnaces. But this quality must be understood with some limitation, as it only relates to the degree of intensity and violent action of the fire. Daily experience proves that this metal may be volatilized, as we frequently find it in the soot of chimneys, where they are in the habit of melting large quantities of silver. Besides which, when exposed to the focus of the most powerful burning glasses, such as Mr. Parker's, it evaporates in a very sensible fume, that rises five or six inches, and completely silvers a plate of metal exposed to its influence. Patrin remarks that in these experiments, where gold and silver is thus melted by the solar rays, the globules of metal acquire a very rapid giratory motion.

Silver is the most ductile of all metals, except gold. A single grain of silver may be extended into a plate of 126 inches long, and half an inch broad: if the grain be reduced into leaves under the gold-beater's hammer, its extension will be still more increased. The tenacity of silver is not, however, in proportion to its ductility, since it is less than even that of iron or copper. A silver wire of a tenth of an inch thick will hardly bear a weight of two hundred and seventy pounds; whereas a gold wire of the same thickness will support a weight of five hundred pounds.

# COPPER.

GENERIC CHARACTER.

Colour red.
Malleable, flexible, and ductile.
Soluble in most acids.
Melts at 27 degrees of Wedgewood's pyrometer.

SPECIFIC CHARACTER.

CUPRUM NATIVUM. C. nudum nitoris metallici. *Linn. Syst. Nat. Gmel.* 3. p. 339.
Naked copper of a metallic lustre.
Cuprum nudum mineræ inherens. *Syst. Nat. Linn.* xii. 3. p. 143. no. 2.
Cuprum nudum malleabile. *Cartheus, Miner.* 69.
CUPRUM NATIVUM. *Waller. Syst. Miner.* 2. p. 274. no. 1.

NATIVE COPPER. . *Cronst. Miner.* 2. p. 678. *Kirwan, Miner.* 2. p. 128. *Brongn. Miner.* 2. p. 211.

COPPER presents itself to our notice under a variety of forms, of which the one we have chosen for our specification is by far the most pure. It occurs either in little leaves in the fissures of mineral bodies, or in grains, or blistered lumps disseminated in argillaceous or ochrey earths. It is to be found, more or less, in almost every copper-mine, though in those of Siberia, especially in the mines of Tourinski, it is remarkably beautiful. It takes the form of cubic or octaëdral crystals of two or three lines in diameter, so arranged one upon the other as to appear like a branched vegetable. Many specimens of this kind of copper are as brilliant as the finest polished gold. The mine in Cornwall can boast many fine pieces of this metal, but they are more commonly in granulated masses than in distinct crystals. The native copper of *Cape Lizard* in Cornwall is very considerable in quantity, but not equal in that respect to what is found at *Huell-virgin* in the same county. There it shoots into various branches, and in various directions, generally taking the form of rhomboidal crystals: some lumps of native copper have been found on this spot weighing from twenty to thirty pounds.

Besides the copper which occurs in its native state, there are several subordinate kinds, mineralized by different substances; among these we shall notice the most remarkable, and then proceed to give some account of the principal copper-mines in this and other countries.

*Red copper ore* is found either under the form of a powder; in transparent filaments variously grouped, and known by the name of *red copper flowers*; in dark red compact masses; or crystallized either in cubes or in octaëdral figures, which are sometimes as bright as rubies. This red kind of copper may be easily confounded, at first sight, with some other minerals of the same colour, but of a different species. It is easy, however, to ascertain this; as the red copper, when put into nitric acid, is dissolved with effervescence, and tinges the menstruum of a green colour.

*Blue oxide of copper* is a very beautiful mineral, and easily detected by its colour. When it is found in an earthy form it is called mountain blue; when crystallized, azure copper. The crystals generally take the form of rhomboidal prisms: sometimes the ore is found in single globules, and sometimes in groups which are striated within from the centre to the circumference.

This mineral is found only in very small and superficial masses, and is of little importance except to decorate the cabinet. It occurs in such trifling quantities as not sensibly to increase the produce of a mine, or to be worth the trouble of smelting by itself. It generally accompanies the malachite copper ore in the veins of primitive mountains; and, according to Brongniart, is almost always imbedded in a ferruginous rock, where the iron is in a state of a red or brown oxide.

*Green copper ore*, when in masses without any particular form, is called *mountain green*; when composed of waved and parallel layers, striated in a particular direction, it is called *malachite*; and when it occurs in delicate fibres united into diverging tufts, it is known by the name of *silky copper*. This is confessedly one of the most beautiful varieties of the mineral kingdom, as the surface of the tufts are generally clothed with the richest velvet green. The green oxides of copper indeed are ranked among the finest ornaments of our cabinets; and although the first place must be given to the silky copper as the most delicate, yet the malachite falls but little short of it in beauty. This frequently vies with the emerald in colour, and the fine polish of which it is susceptible gives it some consequence with the jeweller. Some very fine specimens of this mineral, among a thousand others, were preserved in the ever-to-be-regretted Leverian Museum; but the most remarkable is that mentioned by Patrin, in the collection of Dr. Guthrie at Petersburg: it was 32 inches long, 17 broad, and 2 thick. This specimen was valued at sixteen hundred pounds.

Malachite is sometimes mixed with azure copper, so as to produce a very beautiful effect; and we occasionally see bones, especially the teeth of animals, which have their substance filled either with the azure or the malachite copper ore. When this happens, and the teeth take a fine polish, they are called *turquoise stones*, because they are said to have been first imported from Turkey. They are likewise found in Persia, but they are more subject to turn green than the others. These stones have been much esteemed for seals and other trinkets.

*Gray copper ore* is very rich in metal, yielding from 80 to 90 per cent. of copper, and 10 or 12 of sulphur. It is so soft as to be cut with a knife almost as easily as black lead, and is so remarkably fusible that the flame of a candle is sufficient to melt it.

Copper likewise occurs mineralized by arsenic and other substances; but that which more particularly arrests our attention is the *sulphate of copper*, commonly called *blue vitriol.* This is a metallic salt formed of vitriolic acid and copper, which crystallizes in a very beautiful manner. It is very rarely found in Nature, being generally held in solution by the water which runs from copper-mines, and afterwards deposited either at the bottom or on the sides of the stream. When Dr. Brown, in the year 1673, visited a famous copper-mine at Herngrund in Hungary, he saw two springs called the Old- and New-ziment, which were supposed by the inhabitants to possess the faculty of turning iron into copper. The prepossession of the country-people that this was really the case may be excused, when we consider that they must be totally ignorant of chemical elective attraction, and that the vitriolic acid, having a stronger affinity for iron than copper, will always leave one to attack the other. This is exactly what occurs in Hungary, where old iron is thrown into the water of the spring, conducted into pits, and being there dissolved by the acid, is suspended in the water, whilst the copper is precipitated: the mud is afterwards collected, and being melted in a furnace, produces a very fine copper. From one hundred tons of iron, eighty-four and sometimes ninety tons of fine copper is obtained.

We learn from Bishop Watson, that notwithstanding this method of obtaining copper has been long practised in Germany, it is not many years since any successful attempts of this kind have been made either in England or Ireland. In this last country the discovery seems to have been entirely owing to accident. A great quantity of water, strongly impregnated with sulphate of copper, issues from the celebrated mine at Arklow, in the county of Wicklow, in Ireland. One of the workmen having accidentally left an iron shovel in this water, found it some weeks after so encrusted with a coat of copper, that it was thought to be changed into that metal. The proprietors of the mine, in pursuance of this hint, made proper pits and receptacles for the water, and have obtained, by means of soft iron bars put into them, such quantities of copper, that these streams are now of as much consequence as the mines themselves. One ton of iron produces near two tons of copper mud; and each ton of mud yields, when melted, sixteen hundred weight of copper, which bears a much better price than the copper which is fluxed from the ore.

There is in the Isle of Anglesey, on the coast of North Wales, a mountain called Paris, which abounds in copper ore, the bed of ore being above forty feet in thickness. The lessees of this mine annually raise from six to seven thousand tons of merchantable ore, and daily employ above forty furnaces in smelting it. This ore contains a great quantity of sulphur, which must be separated by roasting before it can be fluxed into copper. The force of the fire dissipates some of the vitriolic acid; what remains attacks and dissolves such a quantity of copper, that the water in which the roasted ore is washed (by means of old iron immersed in it according to the German method) produces great quantities of fine copper, so that the proprietors have there obtained in one year near one hundred tons of the copper precipitated from this water.

The bishop of Landaff, to whom we are chiefly indebted for this information, adds, that if this water was afterwards evaporated, it would yield green vitriol, or vitriolated iron, at nearly the rate of two hundred tons of vitriol for each hundred ton of iron at least; which, at the rate of three pounds sterling per ton, might perhaps produce very good profit to the undertakers, if any should settle such a manufacture there.

Among the most considerable mines of this metal which are to be found in the different parts of the world, may be ranked those of Cornwall, between Hale and Rudworth, which are situated in a regular line along the bottom of the north side of a ridge of granite hills. The veins of mineral run parallel to each other; some of them are four or five feet thick, and are worked to the depth of three or four hundred feet below the surface of the earth. The ore produced mostly consists of yellow or pyritous copper, though native copper is also found in the mines; and it is not a little singular, that this, of all other kinds the richest, should always be met with in the poorest part of the vein, and generally but a little way beneath the ground. The different mines in the neighbourhood of Rudworth are so considerable that 578 men are employed; of whom 150 are engaged on the surface, and 428 underground.

In the island of Anglesey there is a very rich mine which encloses veins of copper of more than sixty feet in thickness, and of an unknown depth. These beds of mineral were discovered in the year 1768, among some mountains, in the neighbourhood of high and steep declivities, which exhibit enormous blocks of white and coarse quartz.

In *Ireland*, in the county of Wicklow, are the mines of Cronebane and of Bally-Murtagh. They are enclosed within a mountain composed of primitive earth, and the copper ore obtained from them is sent to Liverpool to be smelted.

One of the most singular copper-mines in Europe is that of Riegeldorff in *Germany*. It consists of veins of copper mineralized by sulphur and mixed with bitumen. They are situated under beds of chalk, gypsum, marble, and black pyritous slate, in which is frequently found the impression of fish. Under the bed of metal is a bank of sand impregnated with copper, and resting on a thick stratum of a coarse red sand-stone composed of round pebbles, of quartz, and of petrosilex.

The copper-mine of Fahlun, the capital of Dalecarlia, in *Sweden*, may be ranked among those which are considered as the most antient, and at-the same time the most productive. Mr. Coxe informs us that the mine is private property, and consists of 1200 shares, each worth 150 rixdollars, or 37*l.* 10*s.* Four times a week the ore is divided, eleven equal heaps are formed; eight are distributed among eight of the proprietors, and the three remaining heaps are sold by auction, to defray the expenses of the mine and to contribute towards making new excavations. The ore, which consists of pyritous copper, is first roasted in the open air to deprive it of the sulphur, and there smelted; after this operation has been repeated five times, it is brought to the public office and weighed. The proprietors then receive their shares and the king his duty, after which the remainder, consisting of rather more than a twentieth part, is appropriated towards the machinery and other incidental expenses of the mines.

This mine, which extends 1200 feet in length, and 700 in breadth, exhibits an enormous mass of copper ore, nearly in a vertical situation, and pointing from the north-west to south-east. It is encrusted in a kind of slate, and the mountain which contains the mine is composed of micaceous hornstone. Twelve hundred workmen are employed; six hundred of which are miners, and the rest attend to the smelting of the ore, the making of charcoal, and to every thing that is required to be done above-ground.

"The morning after our arrival at Fahlun," says Mr. Coxe, "we visited the mine, and descended as far as we could penetrate. The mouth or opening is extremely large, perhaps the largest in the world, being 1,200 feet in diameter, or near three quarters of an English mile in circumference; an immense chasm, gradually enlarged to the present size by the excavations and frequent downfalls of the rock. We descended this chasm by several flights of wooden steps, till we arrived at the entrance of the first subterraneous gallery; from whence the descent is extremely commodious, not by ladders, as is usual in mines, but down steps cut in the rock, and sloping so gently as to be practicable for horses employed in bringing up the ore. The galleries are from six to ten feet high, and sufficiently spacious. The perpendicular depth of the mine from the top of the chasm is 1,020 feet, and 720 from the entrance into the subterraneous gallery at the bottom. The commodious staircase continued till we came to a deep pit, to which we descended by means of a wooden ladder, and afterwards by an iron ladder, loosely suspended along the sides of the rock; stepping from thence to another wooden ladder, we reached the lowest part to which we could then arrive, as the deepest pit was full of water. Our ascent was long and tedious, and employed near four hours before we again issued into day."

There are two considerable mines in *Siberia*, which differ entirely in their nature from those we have already noticed. They are both situated in the Uralian chain of mountains; one, called the mine of Goumechew, is in the central part of the chain, twelve or fifteen leagues from Ekaterinburg. The other is more than one hundred leagues to the north of this town, and includes the three mines called Tourinski, situated on the river Touria. Most other European mines yield chiefly pyritous copper ore, but these scarcely contain any of that common mineral, the veins being generally composed of red oxide of copper mixed with mountain green. The mine of Goumechew in particular, is celebrated for its malachite, which is there found in finer preservation, and in more beautiful pieces, than in any other part of the world. The mine is in a plain on the border of a lake, and entirely surrounded by primitive mountains. The vein, which is almost in a vertical position, is imbedded in statuary marble five or six fathoms thick, and running from north to south in the direction of the mountains. The mineral is found to the depth of 20 or 25 fathoms, and consists of different coloured clays, which are rich in copper. The fissures or cracks in the vein are lined with the most beautiful malachites and specimens of silky copper.

The mines of Tourinski are on the eastern base of the Uralian chain of mountains, and are separated half a league from each other. They are enclosed within a rock of olive green porphyry, and on the sides and top of the vein there is a very thick and almost vertical bed of coarse white marble. In this, as well as in other respects, the mines resemble that of Goumechew, though they contain a vast deal more copper.

Mines of copper occur in Japan, in China, and among the islands of the Indian sea; especially in Formosa, Macassar, Borneo, and Timor. Among the islands of the Archipelago that of Negropont, and in the Mediterranean that of Cyprus, have been celebrated for their copper-mines.

In *Africa*, likewise, this mineral is occasionally found in the mountains to the north of the Cape of Good Hope, and also in Barbary, in Morocco, and in Abyssinia.

The nature of the copper-mines in *America* is as yet but little known; nevertheless they are exceedingly rich in metal, particularly those of the province of Coquimbo, in Chili, which produce masses of native copper of a most extraordinary size. Those of Peru and Mexico, though better attended to, are less productive.

Masses of native copper are found near Hudson's Bay, but the inhabitants of the country have not the ability to make it useful.

Among the general properties of this metal may be noticed its tenacity, ductility, and malleability. It is so tenacious that a wire of a tenth of an inch in diameter will support two hundred and ninety-nine pounds weight, before it breaks. It is so ductile that it may be drawn into the finest wire, and so malleable that it may be beaten into the thinnest plates. It is said the German artists, especially those of Nurenburg and Augsburg, are acquainted with the best method of giving a fine golden colour to these thin plates of copper by exposing them to the fumes of zinc. The leaves are afterwards beaten as thin as leaf-gold, and, like that substance, put into books of paper in order to be used for the common kinds of gilding. The parings or shreds of copper-leaf, after they have been ground to a powder on a marble slab, are used to cover figures and other ornaments, so as to give them the appearance of real bronze.

Copper, like other metals, in a melted state is remarkably impatient of moisture, and explodes with the most dreadful violence if a little water should unhappily get to the bottom of a mould in a foundery. Cramer mentions a melancholy instance of its violent effects in a brass-foundery in Windmill-street, near Moor-fields, where, it seems, several persons of quality attended to observe the casting of two large brass cannon at a time. The heat of the metal of the first gun drove so much damp into the mould of the second, which was near it, that as soon as the metal was let in, it blew up with the greatest violence, tearing up the ground some feet deep, breaking down the furnace, untiling the house, killing many of the spectators on the spot with the streams of melted metal, and scalding many others in a most miserable manner.

Copper is soluble, more or less, in all acids, and likewise in alkalis. Even pure water, if suffered to stand long in copper vessels, extracts enough to acquire a disagreeable coppery taste. It is a fact well known, though somewhat singular, that fluids should contract more of this taste by standing cold in vessels of this metal, than if boiled in the same for an equal length of time. For this reason, too much care cannot be taken of coppers used for culinary purposes, which ought always to be carefully tinned; or whatever is left to stand in them will acquire, in some degree, the poisonous qualities of the copper.

As a fact of so much consequence to all ranks of people cannot be too strongly enforced, we shall in this place subjoin the remarks which M. Magellan has made on the subject. " Examples," says this gentleman, " are too frequent of the fatal consequences from eatables that have received a taint from copper vessels, and even from silver ones that were largely alloyed with copper, whether on account of the acid nature of the food itself, which dissolves and corrodes the surface of the metal it touches; or from the vessel having contracted the copperish green rust, called *verdigris*, by laying exposed to the air; a poison which is so readily formed as to baffle the common attention of the scullions and cooks. I saw at Paris the melancholy spectacle of a middle-aged man, of a stout bodily complexion, but who laboured under a paralytic disorder, and was deprived of the use both of his limbs and of his intellectual powers during the last four or more years of his lingering life: his disorder was occasioned by eating a fricassee, that remained the preceding night in the copper stewing-pan, in which it had been dressed. Application had been made to the best physicians, but they were unable to give him the least relief from so melancholy a situation."

Magellan speaks in rather strong terms, when he adds that "hardly a year passes without hearing of whole families and numerous guests, that have been destroyed by this kind of poisonous copper, or its green rust, which happened to be dissolved in the soups and stews of their meals; and if death do not ensue, it is certain, at least, that great part of the chronical diseases, palsies, griping in the bowels, and other habitual complaints, which are supposed to proceed from other causes, originate from the pernicious old and vulgar custom of employing this poisonous metal in our kitchens, on account of the œconomy supposed to arise from its durability, and neat appearance."

# IRON.

GENERIC CHARACTER.

Colour dark blueish gray.
Malleable, ductile, and elastic.
Soluble in the mineral acids.
Melts with great difficulty.

SPECIFIC CHARACTER.

Ferrum nativum. F. nudum nitoris metallici. *Linn. Syst. Nat. Gmel.* 3. p. 319.

Naked iron of a metallic lustre.

Ferrum nudum intractabile. *Linn. Syst. Nat.* xii. 3. p. 136. no. 1.

Ferrum nativum in granulis. *Waller. Miner.* 242.

Ferrum nudum malleabile. *Carth. Miner.* 71.

Native Iron. . . *Cronst. Miner.* 2. p. 720. *Kirwan, Miner.* 2. p. 156. *Patrin, Hist. des Miner.* 5. p. 42. *Brongn. Miner.* 2. p. 146.

The observation of M. Patrin, that iron is of all other metals the most useful to mankind, will very generally be allowed; and it may be added, that the bounty of Providence is particularly shown in distributing *that* substance with the greatest profusion which is best calculated to promote our welfare. Wherever it can be of essential service to us, it occurs in abundance: the quantity seems to increase in proportion to our wants, and only falls short where it is scarcely required. This is the case in tropical countries, where the fruits of the earth are liberally provided almost without the labour of the husbandman. In the temperate zones we find the mineral increase, as in those divisions of the globe its services are more necessary; but above all, in the cold climates, where man is doomed to struggle against a stubborn soil and inclement seasons, and where he is subject to a thousand wants, which can only be supplied by the labour of his hands, Nature has placed entire mountains of this metal.

It was for some time a matter of doubt with mineralogists whether iron ever occurred in its native state, that is both malleable and ductile, without the assistance of art. It is now, however, known that native iron exists in many places in as great a state of perfection as if it had just passed through the forge.

This kind of iron is found in two different situations in the earth, and it must be confessed that it is difficult to account for the origin of one of them. In the first case it is met with on the surface of the earth, often in very considerable masses, and insulated as it were on the ground without a vestige of an iron-mine in the neighbourhood, and frequently without any ferruginous earth to accompany it. The masses exhibit a number of pores filled with a vitreous substance supposed to be chrysolite. M. Brongniart has enumerated the principal specimens of this curious mineral which have hitherto been found; and to his account we must acknowledge ourselves chiefly indebted for what follows:

1. A mass weighing about 1600 pounds, and now in the collection of the Academy of Sciences at Petersburg, was found in Siberia, near mount Kemir, between Krasnojarsk and Abakansk; it is entirely composed of very white malleable iron, full of spherical cavities, containing a transparent vitreous substance of a yellowish colour. No trace of any scoriæ is to be found in the neighbourhood, but the mass was enveloped in a ferruginous crust, and situated on the top of a mountain which contained a vein of rich blackish blue mineral, yielding 70 per cent. of iron. The Tartars regarded this iron with admiration, and considered it as a sacred stone fallen from heaven.

2. Another mass like that of Siberia, but weighing several tons, has been found in South America, near St. Jago, in the province of Tucuman, at a place called Olumpa. The iron which composes this mass is cavernous, like that of Siberia, and contains nickel. It is situated in the middle of an immense plain, and is partly sunk in clay, without even a stone to accompany it. In Peru, and in

Mexico, near Toluca, masses of native iron are also found, scattered about the fields, which resemble those already described.

3. An immense mass of native iron occurs on the borders of the Senegal in Africa, which the Moors are, however, obliged to forge before it can be used.

4. In Bohemia a mass of malleable iron has been found like that which was discovered in Siberia, but the vitreous globules which it contains are more abundant, and quite opaque.

5. A mass weighing about 17,000 pounds was discovered at Aken, near Magdeburg, under the pavement of the town, which, according to M. Chladni, has the qualities of steel.

6. In the cabinet of Vienna there is preserved a specimen of this iron weighing about 70 pounds, which does not differ from any of the preceding. It is said to have fallen from the atmosphere in the year 1751, at Hraschina, near Agram in Croatia, and appeared in the air like a globe of fire.

It seems difficult by any hypothesis to account for the appearance of these insulated masses in a satisfactory manner. The general opinion inclines to their having originated from those meteors in the form of globes of fire which so frequently occur in different parts of the world *.

* The stones which have been deposited in the earth by meteors have been accurately investigated by Mr. Howard, and found to contain a considerable proportion of iron. On this account Mr. Sowerby has introduced them into his elegant British Mineralogy under the title of native iron.

The other state in which we find native iron has nothing ambiguous about it, since it occurs in veins mixed with other metals. Schreber found it in a mountain near Grenoble, and Bergman in a matrix of brown garnets in Saxony.

Iron, like other metals, is found in different states, from whence it takes particular names. Thus we have the *Hæmatite iron ore*, of a black, red, or yellow colour. This is a rust of iron which, being conveyed by water and deposited in the cavities and on the walls of mines, is found in the form of stalactites, or sometimes in little round knobs, collected together so as to resemble grapes. The internal structure of these masses of iron have a fibrous and striated appearance like wood, and are generally so hard as to strike fire with steel.

Very beautiful specimens of *crystallized iron ore* are found in the island of Elba, on the coast of Tuscany. They exhibit various gradations of the finest colours, as red, blue, green, yellow, brown, black; and look, to use the expression of a mineralo gist, like so many clusters of emeralds, sapphires, diamonds, rubies, and topazes.

*White spathose iron ore* is another state in which we find this metal, but it is white only when first dug from the bowels of the earth; soon after which it becomes gray, then brown, reddish, or yellowish.

*Argillaceous iron stone*, of a blackish brown colour, is frequently found in large quantities; and as it contains a considerable portion of metal is worked to great advantage. On an ore of this kind the celebrated iron-founderies of Carron in Scotland are principally established.

Iron-stone is found in abundance in Derbyshire, at various depths from the surface of the earth. The most valuable beds of this mineral which have yet been discovered, are in Morley Park, near Heage; at Wingerworth, Chesterfield, and Staveley. In Cumberland argillaceous iron-stone is very commonly met with either on or near the surface in most parts of the county. In the parish of Egremont, at a place called Crowgorth, there is a mine of this ore. It is described as lying in the earth at the depth of twelve fathoms; and the thickness of the band of ore, which is hard solid iron-stone, is between twenty-four and twenty-five feet. It was never considered of much consequence till the year 1784 and 1785, when it was more generally opened; and the demand for it has since been so great, from different founderies, that in 1791 and 1792 the annual exportation was more than 20,000 tons. Masses and beds of this mineral are likewise found in Glamorgan, Monmouth, Staffordshire, Shropshire, and in different parts of Scotland.

There is hardly a country in the world without its mines of iron, and most of them possess a considerable number. Of these we shall just notice a few, and refer our readers for a more particular enumeration to Brongniart's *Traité Elementaire de Mineralogie.*

The principal mines of *Sweden* are those in the environs of Phillipstadt, that of Taberg in Smoland, which is remarkable for its numerous vertical and parallel veins of metal, and the mine of Danemora, of which Mr. Coxe has given the following description in his Northern Tour:

"After dinner we walked to the mines, which seem to differ from all others, inasmuch as they have no subterraneous galleries, but are worked in the open air. The pits are deep excavations, like gravel-pits, and form so many abysses or gulfs. The descent is not, therefore, as usual in mines, down a narrow subterraneous shaft. Here I stepped into a bucket, and hung suspended in the open air, in the same manner as if a person was placed in a basket at the top of Salisbury spire, and gradually let down by a rope and pulley. The inspector accompanied me to the bottom, and, while I was placed at my ease in the inside on a chair, seated himself on the rim of the bucket, with his legs extended to maintain the equilibrium; with a stick he gently touched the sides of the rock and the rope of the ascending bucket, to prevent our bucket from swerving against them, which would have infallibly overset us.

"While I hung suspended in mid air, and so giddy that I could not venture to look down, I observed three girls standing on the edge of the ascending bucket, and knitting, with as much unconcern as if on terra firma; such is the effect of custom! We employed five minutes in descending, and the depth which we reached before I stepped out of my aërial seat was five hundred feet. Not being a mineralogist, my curiosity was soon satisfied; I again entered the bucket, and was drawn up in the same manner. In this situation I closed my eyes and conversed in Latin with the inspector. He informed me, the richest ore yields 70 per cent., the poorest 30; on an average the collective mass gives one-third of pure mineral; 12,000 tons are annually drawn from the mines, which yield 4,000 tons of bar-iron. The mass of ore occupies a small compass. The length of the pits, considered as one, is 760 feet, and the breadth from three to twelve. The ore runs in veins from east to west; the richest is near five hundred feet in depth, and the Storoe Grube is not yet fathomed. The matrix of the ore being a calcareous earth, contains but little sulphur, which is perhaps the reason of the superior quality.

"The mines of Danemora were discovered in 1488. They consist of twelve pits, belonging to thirteen proprietors; of whom baron Geer possesses more than one-third. The proprietors work each pit separately, defray the expenses, and divide the profits according to their respective proportions. The ore which is dug in summer is laid out in heaps, and divided in the winter months, from November to March, when it can be conveyed on sledges; the proprietors send it to their respective forges, or sell it on the spot. Near three hundred persons are employed in mining and transporting the ore; the miners are paid by the work, and can gain at most fifteen pence halfpenny per day; the other workmen can earn thirteen pence. The water is drawn out of the pits by means of pumps worked by water. These pumps are of great length, and occasion considerable expense for repairs. A steam-engine was once employed for this purpose, but laid aside on account of the scarcity and dearness of charcoal."

The iron-mines in *Siberia* concur with those of Sweden to furnish most of the iron used in Russia and the rest of Europe. The two principal mines are on the borders of the Uralian mountains, one thirty, and the other fifty, leagues to the north of Ekatherinburg. The first is in a mountain of about four hundred feet high, and the veins of mineral, which are nearly vertical, run north and south. The summit of this mountain in particular is almost one mass of mineral, which is said to extend two hundred fathoms in length, and half as much in breadth. The veins consist of rich black iron ore, separated from each other by beds of slate and stone. The Russians annually draw from this mountain two millions of *pouds*, or about thirty-four thousand tons of mineral that produces excellent iron.

The other mine is situated in a mountain of a similar shape, and celebrated for the loadstones which are found in it. Blocks are occasionally discovered of forty pounds weight, and great attractive power. Many small ones are likewise found, but they have not the ability to support a weight in proportion to those of a larger size. Patrin says he has met with some that would support twenty-five times their own weight. It appears that the other mountain contains loadstones on its summit, but attended with a singularity that makes them useless; for as soon as they are detached their poles become multiplied and confounded together.

All iron ore, after it is dug from the mine, must be smelted before it is fit for use. To effect this, furnaces of very considerable magnitude are constructed, of the shape of an egg, with the largest end toward the ground. The inner wall is built of fine stone, which powerfully resists the heat, and this is surrounded with more building till the conical shape is lost, and the whole forms a square gradually converging towards the top. These buildings are from 16 to 25 feet high, and from 10 to 14 in width, in the inside. Near the bottom of the furnace there is an aperture for the insertion of a large pair of bellows worked by a steam-engine, and two or more holes are left ready to be occasionally opened at the bottom to permit the melted metal to flow out, and to remove the scoria. When the inside of the furnace has been strongly heated by throwing in charcoal and coke with lighted brush-wood, the process of smelting begins, and fuel, ore, and flux, in alternate layers, are continually put in day and night. The flux which is used to assist in melting the metal is generally limestone, and the workmen never let the fire go out till the furnace wants repair, which is frequently a period of some years. The ore thrown in, in the manner just described, gradually subsides into the hottest part of the furnace, where it becomes fused, and the melted metal falling to the bottom, is let out by a trap-hole into furrows made in a bed of sand: the large mass which sets in the main furrow is called a *sow*, and the lesser ones *pigs*, of iron. Chimney backs, stoves, garden rollers, &c., are formed of this rough metal, taken out of the receiver with ladles, and cast into moulds made of fine sand. The best raw iron, though all possible care may be taken to free the ore from the different substances with which it is mixed by the usual process of smelting, is never malleable. To effect this, the impure cast iron is melted a second time in another furnace intermixed with charcoal. The iron, which is then called a *loop*, is conveyed under a large hammer raised by the motion of a water-wheel, and there beat into a thick square form. This operation several times repeated, heating the metal each time till it is almost ready to melt, at length makes it completely malleable, so that it may readily be formed into bars for sale. Cast iron has of late been brought into the malleable state, by passing it through rollers instead of forging it.

The tenacity, ductility, and malleability of iron is very great, and, according to Magellan, it exceeds every other metal in elasticity and hardness when properly tempered. An iron wire a tenth of an inch in diameter will support 450 pounds weight. It extends with some difficulty under the hammer, but it may be drawn into wire as fine as a hair.

# TIN.

GENERIC CHARACTER.

Colour grayish white.
Crackles when bent.
Soluble in cold aqua regia, but not in the mineral acids separately without heat.
Melts more readily than other metals.

SPECIFIC CHARACTER.

STANNUM NATIVUM. S. album nitoris metallici purum. *Linn. Syst. Nat. Gmel.* 3. p. 310.

Pure tin of a white colour and metallic lustre.

STANNUM NUDUM. *Linn. Syst. Nat.* xii. 3. p. 236. no. 1.

NATIVE TIN. . . *Cronst. Miner.* 2. p. 6. 26. *Kirwan, Miner.* 2. p. 196. *Patrin, Hist. des Miner.* 4. p. 283. *Brongn. Miner.* 2. p. 188.

BRONGNIART says that the existence of native tin still remains a problem, and that the specimens which have hitherto been regarded as such were probably produced by art, and after laying for a great length of time in the earth have been brought to light. In this, however, he differs from Mr. Kirwan, who is fully persuaded that tin exists in a native state, and that the great scarcity of the metal in general will sufficiently account for its being so seldom found. In the Philosophical Transactions for the year 1766, notice is taken of a piece of tin ore in a mass, inclosed within a kind of quartz-stone, or rather in a hard crust of crystallized arsenic. This lump, weighing near twelve pounds, was found near Granpont in Cornwall, and was so well covered with its crust, that its extraordinary weight alone betrayed it. "The fragments still in the possession of Mr. Rosewarne in that place prove by the granulated external surface and shotten edge, to be native tin."

Kirwan tells us that the best tin ores are those that are washed down the hills by torrents, and thence called *stream tin ores*; the tin extracted from them is called grain-tin, and not easily procured in general. Common block-tin, being extracted from ores containing sulphur, is not quite so pure. The stream-tin from Pensagillis is said to have gold occasionally mixed with it, and that this precious metal has been found, though very rarely, in pieces of the value of two or three pounds sterling.

Tin, of all the metallic substances, is found nearest to the surface of the earth. It is not, however, on that account more readily discovered. The veins of other metals are easily detected by the different stony or slaty substances which accompany them; but the presence of tin is announced only by a brownish or reddish appearance, which pursuing its course through decomposed granite, may often be mistaken for mica. Again: tin is not, like most other metals, to be found in a multitude of different places, and covering a great extent of surface, but is confined to particular situations, and included within a moderate space. The ore is almost always found in granite, or in slate immediately in its neighbourhood, and which is generally decomposed and reduced to a black sand.

Tin is almost confined to *Europe*, and is but sparingly dispersed even in this quarter of the world. In the vast peninsula of Malacca, and in the island of Banca, in the East Indies, we hear of tin-mines; but most of the extensive countries in that region of the globe, as well as the dry and sandy continent of Africa, are totally destitute of this metal.

England, above all other countries, can boast the richest tin-mines. Those of Cornwall have been worked from time immemorial, and still continue to yield vast quantities of ore. The veins of mineral either run in slate or granite. Those which are found in the granite are of less extent, and diminish in size as they increase in depth, while the veins which traverse the slate preserve nearly the same magnitude for several hundred yards. Among the mines of tin which this country produces, those of Huel-cock and Penzance are remarkable for having their veins run under the sea. The mine of Huel-cock, in the parish of St. Just, is worked to the length of eighty fathoms beneath the sea. In several places the distance which separates the workmen from the element which roars above them is not more than three fathoms, so that they can hear the dashing of the waves. They have even had the rashness to pick out certain parts of the vein which has been richer than common, so as to leave a roof of only a few feet in thickness. In these places the noise of the waves, whenever the weather is violently tempestuous, is so awful, that the workmen are terrified, and leave the mine, expecting it to be swallowed up by the sea.

At Polgooth, about two miles to the south-west of St. Austel, there are very rich and extensive tin-mines, situated in a part of the country which for many miles around has a most bleak, desolate, and barren appearance. This aspect contributes, with the sallow and miserable look of the miners, to excite very gloomy and melancholy ideas. The *shafts*, by which the miners descend and the ore is raised to the surface, are scattered over a considerable extent of barren ground, and are more than fifty in number; twenty or thirty of which are constantly in use. The descent into the mine is by means of ladders, placed almost perpendicularly: at the foot of each ladder is a narrow break, or landing-place; and at certain intervals are openings into different beds of ore. Whenever a stranger is inclined to descend into these mines, he is previously accoutred with a flannel shirt and trowsers, a close cap, an old hat to shelter his face from droppings, and a thick pair of shoes. A lighted candle is put into one hand, and a spare one suspended to a button of his jacket. Every part of the ordinary dress is laid aside, and the flannel dress worn close to the skin, in order to absorb the profuse perspiration which the closeness of the mine, or the labour of mounting the ladders may occasion.

Dr. Maton (to whose excellent Observations on the Western Counties we are chiefly indebted for this information) observes, that the main vein of ore, which is about six feet thick, runs from east to west, and dips to the north at the rate of about six feet in a fathom. Towards the east it divides into two branches, and there is another that cuts the former nearly at a right angle, and consequently runs north and south, dipping to the east. We are told that the depth of the engine-shaft is one hundred and twenty-four fathoms, and that the machine draws up a column of water at each stroke, fifty-six fathoms deep and fifteen inches in diameter. At about fifty or sixty feet below the surface of this mine, the water that oozes through the different strata begins to form a small stream, which, if suffered to collect, would soon overflow the bottom of the mine: this inconvenience is effectually remedied by an immense steam-engine, which, as we have just observed, raises the water to the surface, and that with such force that it runs from the mine like a river.

It may not be improper in this place to add a few particulars respecting the œconomy of tin-mines, as they have lately been described by an intelligent traveller. As soon as a shaft* has been sunk to some depth, a machine, called a *whim*, is erected, to bring up either rubbish or ore, which is previously broken into convenient fragments by pick-axes and other instruments. The whim is composed of a perpendicular axis, on which turns a large hollow cylinder of timber called the cage, and round this a rope winds horizontally, being directed down the shaft by a pulley fixed perpendicularly over the mouth of it. In the axis a transverse beam is fixed, at the end of which two horses or oxen are fastened, that go their rounds, hauling up a bucket full of ore or rubbish, while an empty one is descending. In some mines the whim is worked by steam. The ore is blown out of the rock with gunpowder, and, when raised from the mine, is divided into as many shares as there are lords and adventurers; and these are measured out by barrows, an account of which is kept by a person who notches a stick. Every mine is allowed to distribute its ore on the adjacent fields, and this is generally pounded or stamped on the spot, in the stamping-mill. This mill is a machine constructed for the purpose, and worked by water; it pounds or stamps the ore previous to its being carried to a large vat, where it is washed from all its filth, and prepared for the smelting-house. The foreman, or principal servant, employed by a company of ad-

* A narrow perpendicular passage into a mine.

venturers, and called the *captain*, keeps the accounts, pays and regulates the mines, and manages a variety of concerns. Besides this man there are *under-ground captains*, as they are called, who have the immediate inspection of the works below, or in the mine survey the ladders and ropes, and generally overlook all the different objects connected with the working of the mine.

Among the tin-mines in other parts of Europe may be noticed that of Marienburg in *Upper Saxony*. This mine, according to Jars, is situated in a mountain called Wildberg, and the principal vein is about a fathom in thickness. Towards the middle of the vein there is a streak, seven or eight inches thick, of yellow copper ore containing silver, and mixed with the tin. The matrix of the vein is a gray slate, studded with black and white mica. The mine has been worked to the horizontal extent of forty fathoms, and to the depth of twenty-seven.

At Gayer in Saxony, there is a large mass of mineral situated on the top of a mountain, and containing a quantity of tin. This mine has continued to produce metal since the twelfth century, and encloses a number of little veins of mineral, the most part of which contain tin. When Jars visited these mines, the workmen had penetrated to the depth of sixty fathoms, where they found some excellent mineral. He describes the veins as lying between beds of stone and slate, and says that they produce good tin principally where they cross the great mass. The quantity, however, is very small in proportion to the other materials, only from 150 to 200 pounds of smelted tin being produced from 45 thousand pounds of ore. Notwithstanding the extreme poverty of the mine it is very profitable, on account of the ease with which the metal is obtained, and the cheapness of labour in that country.

In *Bohemia* there are some tin-mines which are sufficiently productive to make the working of them profitable. That of Platten has been penetrated to the depth of eighty fathoms, and contains ten separate veins, which, however, are very near each other, and continue to run parallel till they pass a layer of clay forty fathoms below the surface. Immediately beneath this argillaceous bed the majority of the veins unite, and form three or four, from two to five fathoms long. They are very rich in crystallized tin ore, and are said to become more so as they decrease in size. A phænomenon worthy of observation, and said to be pretty constant, is, that where several veins reunite, the mineral is always most abundant.

There are mines scattered about Europe which contain a portion of this metal, but the quantity in general is very confined. It appears singular that in Siberia, which is so rich in other metals, not a single vein of tin should ever have been found, though every search has been made for it, in consequence of the high premiums offered by the Russian government for the discovery.

The position of the mines from whence the antients derived their tin is an interesting historical point which has not as yet been satisfactorily settled. Some suppose the Cassiterides, now called Scillæ, were the islands from whence the Phenician merchants drew their tin, and that Cornwall furnished them with a considerable quantity; while others think the antients were indebted for this useful metal to some islands situated on the coast of Galicia, in Spain.

Tin is of all metals (quicksilver of course excepted) the most fusible, since it requires only twice the heat of boiling water to melt it. It possesses so little ductility that it cannot be drawn into wire, though it may be extended between rollers or beat into thin plates. The crackling noise which tin makes when it is bent in different directions, is a property peculiar to this metal, and is supposed to be owing to the arsenic which may be mixed with it, since those operations by which this pernicious semimetal is separated from tin, destroy its crackling noise.

Tin is applied to many purposes in the arts. It is mixed with quicksilver in order to make looking-glasses, and is particularly serviceable as a coating to many of our vessels. Those metallic plates generally called tin, are merely plates of iron which have been dipped in this metal, and which are afterwards formed into a variety of utensils used for culinary and other purposes. Before the sheets of iron are tinned they are cut to a proper size, and steeped in a solution of sal ammoniac, or in an acid liquor produced by the fermentation of barley-meal. After this process they are well scoured, till the whole surface becomes clean and bright. They are then dipped into an iron pot filled with melted tin, whose surface is covered either with suet, fat, or pitch. When the plates are drawn out, both their surfaces are completely coated with the metal, and in this state they compose a very clean and useful material for many of the common purposes of life.

In Cornwall, the tin, after being smelted from the ore, is poured into quadrangular moulds of stone, containing about three hundred and twenty pounds weight of metal, and it is then called *block-tin.* The officers appointed by the Duke of Cornwall assay it, by taking a piece of the under corners of each block; and, if found pure, it is stamped with the seal of the duchy.

# LEAD.

GENERIC CHARACTER.

Colour blueish white when first exposed to the air.
Soluble in most acids.
The most fusible of metals except tin.

SPECIFIC CHARACTER.

PLUMBUM NATIVUM. P. nudum. *Linn. Syst. Nat. Gmel.* 3. p. 364.
Naked lead.
Plumbum nudum granulatum. *Cartheus, Miner.* 65.
PLUMBUM NATIVUM. *Waller. Miner.* 272.

NATIVE LEAD. . . *Cronstedt, Miner.* 2. p. 651. *Kirwan, Miner.* 2. p. 203. *Brongn. Miner.* 2. p. 194.

KIRWAN allows that the existence of lead in its native state is at present very generally denied; yet he thinks that to deny it absolutely is in this, as in many other cases, rather rash, particularly as the specimen found in Monmouthshire has all the appearance of being in a perfect metallic state, and no solid proof, deserving attention, nor even a wellgrounded suspicion of its having been produced by art, has as yet been adduced.

Magellan quotes Bomare's Mineralogy for a curious specimen of native lead kept in the collection of Abbé Nolin at Paris, that had been found in the lead-mines at Pompean, near Rennes, in Brittany. This metal was very malleable, could be cut with a knife without crumbling, and easily melted over the flame of a candle. It weighed about two pounds, was imbedded in an earthy lead ore of a reddish colour, and had a slaty vein that went through it. Magellan thinks that these circumstances are sufficient to stamp it a natural production.

Notice is likewise taken in the Philosophical Transactions for the year 1772, of some pieces of native lead found in Wales; and Wallerius assures us that this metal has been found in its metallic form in Poland. With these proofs of its existence, besides others which might be adduced, we feel satisfied that native lead, though a very rare substance, may sometimes occur within the bowels of the earth.

Among the lead ores in a mineralized state, that which is mixed with sulphur, and known by the name of *Galena*, is by far the most abundant. This lead ore is found in very considerable masses, both in primitive and secondary mountains, particularly in those which contain marble, where it is disposed either in thick veins or immense beds. It is accompanied by almost every sort of matrix, and by all those metals which are likely to occur in the same situation. Brongniart says that galena appears to have been formed by nature at different æras, but most abundantly towards the last moments of the general formation, since the mines of this metal are for the most part found in the secondary earths which frequently alternate with banks of chalk containing shells.

This kind of lead ore is commonly crystallized in cubes, though it is by no means confined to this particular formation. The colour is a dark blueish gray, and the surface very bright. Most part of these ores contain more or less of silver, though the quantity is frequently so small as scarcely to be noticed.

Lead is mineralized by other substances besides sulphur, from whence it takes different names: thus we have phosphorated lead ore, arseniated lead ore, and vitriolated lead ore. We have likewise several kinds named from their colour; such as white, gray, red, and yellow lead ore: but as none of these contain any thing interesting in their descriptive characters (except to the scientific mineralogist) we shall pass on to the principal mines of this useful metal that at present exist in the different parts of Europe.

*England* is very rich in lead, this mineral being found in great abundance in several parts of the country, particularly in Derbyshire. It is likewise one of the principal metallic substances in the county of Cumberland, Alston-moor being famous for its lead-mines, which employ eleven hundred men, and produce to their owners a clear income of more than sixteen thousand pounds a year. In working some of these mines, we are told the miners often find large breaks in the rock, like grottos, entirely encrusted with very beautiful spar, which by torch-light appear as if covered with precious stones. These openings are generally closed up as soon as they are perceived, that the workmen may not be tempted to leave their business in order to collect and sell the spar, by which they are enabled to make a great deal of money.

The productive veins of lead in Derbyshire run in layers of calcareous earth, more or less mixed with shells; and sometimes penetrated to the depth of more than twelve hundred feet. Their situation is almost vertical, and their direction *generally* from the north-west to south-east. The calcareous layers are frequently interrupted by beds of toadstone, so called from being formed of white grains upon a black ground. The thickness of the calcareous layers is from one to two hundred feet, and the toadstone is sometimes of an equal volume; but this substance is found to vary exceedingly in this respect. We have been thus particular in describing the layers, as it leads to a circumstance worthy of remark, and which we have formerly noticed in our Introduction to the minerals.—It is, that the veins of metal, though very rich in the calcareous earth, immediately cease upon meeting with toadstone, so that not a vestige of metal is to be found in that substance.

The oldest mine in this county is situated near Castleton, towards the bottom of *Man Tor*, or the shivering mountain. This has probably been worked from the time of the Saxons, and derives its name from their god *Odin*. It furnishes employment for about 140 persons of all ages, and consists of two *levels*, running horizontally into the mountain: from the upper level the ore is brought from the mine, while the lower one serves as a water-level to drain the works. The vein of metal varies in thickness, and has been traced in some places a hundred and eighty feet below the horizontal surface; in others, as much above it. The ore differs in quality; the best is said to yield about three ounces of silver to a ton of lead.

In the neighbourhood of this mine there is another, which exhibits to the traveller a striking instance of the uncertainty that sometimes attends the mining business. It has been named Speedwell level, or Navigation mine, and was excavated in search of lead ore by a company of adventurers from Staffordshire, who, after expending fourteen thousand pounds and eleven years ceaseless labour in pursuit of that which they never found, abandoned the undertaking.

This very singular mine has been thus described: The descent is beneath an arched vault by a flight of 106 steps, which lead to the sough, or level, where a boat is ready for the reception of the visitor, who is impelled along the water by the motion communicated to the boat by the guide, who, to effect his purpose, pushes against wooden pegs driven into the sides of the rock at six feet distance from each other. The depth of the water is about three feet, and the channel through which it proceeds was blasted through the heart of the rock, which was found of such solidity and hardness, that implements of sufficient temper could hardly be procured to penetrate it. As the boat proceeds, several veins of lead-ore may be observed in the rock, but of insufficient value to defray the expense of working them. At the distance of six hundred and fifty yards from the entrance, the level bursts into a tremendous gulf, whose roof and bottom are completely invisible; but across which the navigation has been carried, by flinging a strong arch over a part of a fissure where the rocks are least separated. Here, leaving the boat, and ascending a stage erected above the level, the attention of the visitor is directed to the dark recesses of the abyss beneath his feet; and firm indeed must be his resolution, if he can contemplate its depths unmoved, or hear them described without an involuntary shudder. To the depth of ninety feet, all is vacuity and gloom; but beyond that commences a pool of Stygian waters, not unaptly named the *Bottomless pit*, whose prodigious range may in some measure be conceived, from the circumstance of its having swallowed up more than forty thousand tons of the rubbish made in blasting the rock, without any apparent diminution either in its depth or extent. The guide, indeed, informs you, that the former has not been ascertained; yet we have reason to believe that this is incorrect, and that its actual depth, in standing water, is about three hundred and twenty feet. There cannot, however, be a doubt, but that this abyss has communication with others, still more deeply situated in the bowels of the mountain, and into which the precipitated rubbish has found a passage. The superfluous water of the level falls through a water-gate into this profound caldron, with a noise like a rushing torrent.

The fissure is calculated at about two hundred and eighty yards below the surface of the mountain; and so great is its reach upwards, that rockets of sufficient strength to ascend four hundred and fifty feet have been fired without rendering the roof visible. The effect of a Bengal light discharged in this stupendous cavity is extremely magnificent and interesting. Beyond the fissure the level has been driven to a similar length to that part which precedes it; but in this division of its course little occurs to excite observation.

Among the different lead-mines in England may be mentioned those in the Mendip hills in Somersetshire, which have long continued to yield considerable quantities of ore.

*France* produces lead in great abundance, thirty thousand quintals being annually raised, according to the *Journal des Mines*, in the different departments:—two-thirds of this quantity is extracted from the mines of Brittany, and the other third from those in the Vosges, the Cevennes, and the Pyrenees.

At Pompean, near Rennes, the ore lies in a bed of blueish clay twelve fathoms thick, which extends to a length unknown; successive veins of mineral are to be found in it, the most of which are directed from north to south. This mine has been worked to the depth of four hundred feet, and to the extent of about six hundred fathoms. In the veins of mineral, which are described as being nearly in a vertical situation, are found marine shells, pebbles, and pieces of fossil wood, which is said to be a species of chestnut. This singular appearance occurs at the depth of two hundred and forty feet below the surface of the earth.

At Poullaouen, in the department of Finisterre, there is a vein of this mineral, discovered in the year 1741, and from thence called the New mine, which at first promised to be exceedingly rich: nevertheless, the vein, from being five or six feet thick, divided as it descended below the ground, and was lost; but the workmen persevered, and followed it five hundred feet beneath the surface, where they met with it again nearly in its primitive state, and full four feet in thickness.

But the mine of Huelgoat is the most important in Brittany. It is situated on the side of a slaty mountain, and has been worked for the three last centuries. The lead ore has been traced to the depth of six hundred feet, and runs north and south, with an inclination of seventy-two degrees. This mine is famous for producing fine cabinet specimens of lead.

At Bleyberg, in the duchy of Carinthia, in *Germany*, there is a mine well known for the yellow lead which it produces, as well as for the singular disposition of its veins, which, to the number of fourteen, are ranged one upon the other, with an equal number of calcareous layers between them. These last are almost full of shells, and compose the beautiful shining marble called *lumachelle.* At Tarnowitz, in the principality of Oppeln, in Silesia, there is a mine in which the veins are disposed in a similar manner, resting on thin horizontal layers of marble mixed with fossil shells, black earth, and asphaltum.

The principal lead-mines in *Spain* are situated in the granite hills of the province of Jaen, and in the jurisdiction of the little town of Canjagar.

The other quarters of the world are by no means so rich in lead as Europe. Patrin remarks that in *Northern Asia* the Uralian mountains, which form such an immense chain, extending from north to south at least five hundred leagues, rich in copper and iron, contain only one mine of lead. Again, the vast chain of Altaic mountains, which separate Siberia from Chinese Tartary, and which are yet more considerable than the others, produce no more, though they abound in mines of copper, gold, and silver.

The uses of lead are too well known to require pointing out, as the metal is daily employed for some purpose or other, in almost every family. It is easily extended into thin plates, though its tenacity is so trifling that a leaden wire a tenth of an inch thick, will not support a weight of thirty pounds. Sheets of lead are made by passing this metal, without heat, between two cylinders, or rollers of iron, by which means they are rendered of an uniform thickness, and as smooth as the rollers themselves. This is called milled-lead, and it is said to be harder and more brittle than cast sheet-lead, which may be safely bent in any way without cracking. The cast sheets of lead are made by pouring this metal, when fused, upon the top of an inclined table with a flat surface. If the sheets are required to be thin, the bottom is covered with a woollen, and above this with a linen cloth, neither of which is at all scorched by the metal; and the thickness of the sheets will depend, in a great degree, on the velocity with which the melted metal descends. For making thick sheets of lead, the bottom of the table is covered with damp sand, properly levelled, and the fused metal is conducted over it by a wooden strike, which bears on the borders of each side.

*White lead*, so well known for its great use in painting, is nothing more than sheets of this metal dissolved by vinegar. In France they put, for this purpose, some weak vinegar into glazed earthen pots, upon which the plates of lead, loosely rolled up in a spiral form, are placed, so as not to touch the vinegar. The pots are then covered with a thicker plate of lead and disposed side by side, sometimes to the number of fifteen thousand, in a bed of dung. As soon as the heat is sufficient to volatilize the vinegar, it attacks the metal, and in about four or five weeks the plates are completely covered with a coat of white lead. This substance is then detached from them by passing the plates between channelled rollers under water; a very proper precaution, to prevent the noxious exhalations which would otherwise arise from the lead to the destruction of the workmen. In England this process is conducted in a more cleanly manner, tan being used instead of dung.

*Red lead* is another preparation of this metal, of equal importance with that we have just described. In Derbyshire there are several mills and furnaces employed solely for the purpose of making red lead. The furnaces resemble a baker's oven, having a low vaulted roof and two party walls, which leave a middle space where the pit-coal is burned. The flame, being drawn over the party walls, strikes on the roof, and thus produces a reflected heat sufficient to melt the lead on the floor of the furnace. The surface of the melted metal being exposed to the air becomes instantly covered with a dusky pellicle, which is removed as soon as formed, till most of the lead is reduced to a yellowish green powder. This powder is afterwards ground in a mill, and then being washed and passed through a sieve in order to separate the particles of lead which remain, it becomes of an uniform yellow colour, called *massicot* by the painters. This yellow powder, being well dried, is thrown again into the furnace, where it is constantly stirred in a continued heat, so that in about forty-eight hours it acquires a vivid red inclining to orange colour, and is known by the name of *minium* or *red lead.*

The heat employed in the manufactory of red lead must not exceed a certain degree, or the metal will be converted into a yellow flaky calx called *litharge.*

# MERCURY.

### GENERIC CHARACTER.

Colour and lustre of polished silver.
Evaporates at the heat in which lead melts; becomes solid at 40° below zero of Fahrenheit's thermometer.
Soluble in nitrous acid, and also in the vitriolic, when strongly heated.

### SPECIFIC CHARACTER.

| | |
|---|---|
| HYDRARGYRUM VIRGINEUM. | H. nudum, liquidum, ponderosum, coloris nitorisque argentei. *Linn. Syst. Nat. Gmel.* 3. p. 374. |
| | A heavy, liquid, base metal, of a shining silvery colour. |
| | Hydrargyrum nudum nativum. *Woltersd. Miner.* 26. |
| | MERCURIUS VIRGINEUS. *Waller. Syst. Miner.* 2. p. 148. no. 1. |
| NATIVE MERCURY. . . | *Cronstedt,* 2. p. 586. *Kirwan, Miner.* 2. p. 223. *Brongniart, Miner.* 2. p. 148. no. 1. |

NATIVE mercury, or quicksilver, is found disseminated in little globules in different mineral substances, from whence it may be easily extricated, either by heat or a few strokes with a hammer. It occurs in almost all the mines which contain mercury in a mineralized state, when it trickles along the fissures of the rocks, and sometimes collects in considerable quantities in their natural basons.

Sometimes this metal is amalgamated with native silver, when it forms a solid shining white substance, very brittle, and easily decomposed by heat. In this state of amalgam it is found at Stalberg in Sweden, at Rosenau in Hungary, and especially at Moschel-Landsberg in the duchy of Deux-Ponts, where it is met with in common ferruginous clay, mixed with other mercurial ores.

The other states in which this metal is principally found, are mixed with sulphur in the shape of cinnabar, or mineralized by the vitriolic and marine acids. The former is of a fine deep red, but subject to vary in the depth of its colour, as well as in its form, being sometimes found in a mass, and sometimes in regular hexaëdral crystals. The latter is a pearly gray, frequently inclining to a yellowish green. It has the softness of wax, is generally transparent, and may be volatilized by the blowpipe without being decomposed.

The mines of this valuable and singular metal are chiefly confined to Europe and America.

In *Spain*, that of Almaden in the province of La Mancha is particularly famous for producing abundance of quicksilver. It is said to be the most antient in Europe, since, according to Pliny, it was worked five hundred years before the Christian æra; and he tells us, that in his time ten thousand pounds weight of cinnabar were annually transported to Rome; some for the use of the painters, and the rest to rouge the ladies.

This inexhaustible mine is situated in a branch of the Sierra Morena, or black mountain, on the confines of Andalusia, fifteen leagues to the north of Seville, and seven or eight to the south-west of the famous silver-mine of Guadalcanal. There are two principal veins, from two to fourteen feet in thickness; these throw out a number of branches in different directions, but towards the middle of the hill they reunite, and form an immense mass of mineral. The matrix of the veins is, like the rest of the hill, composed of free-stone, and it is observed that the cinnabar is most abundant where the stone is of the finest texture.

The veins are coated with a black and rotten kind of slate, which, however, often contains good cinnabar, as well as coarse round and flat pyrites, in masses of sixty pounds weight, which exhibit spots of cinnabar within.

The mine of Almaden, before the year 1752, furnished annually five or six thousand quintals of mercury for the use of the mines in Mexico; but since then, that of Guanca-Velica being almost exhausted, they have drawn from Almaden the mercury necessary for the Peruvian mines, and at present the annual produce is said to be increased to sixteen or eighteen thousand quintals.

The mine next in consideratiou, if not equal to that of Almaden, is situated at Idria in *Germany*.

Idria, says a French mineralogist, is a little town, irregularly built on both sides of a river, which runs through a very deep valley surrounded by mountains composed of lime-stone. In this valley there are large beds of black slate, which contain the mercury either in the state of quicksilver or cinnabar. The mine is worked to a very considerable depth, the principal shafts being sunk more than a hundred fathoms; and it is said to be sufficiently productive to furnish all Europe and America with quicksilver, if they were not restrained from extracting it in order to keep up the price. The extraction is limited to three thousand quintals per annum, in which quantity there is about a hundred quintals of native mercury. This rich mine is said to have been discovered in the year 1497; but the mountain where the metal was first found is now exhausted and abandoned.

In *France* we find mines of mercury situated in the mountains which make part of the Vosges, and which include an extent of country of seven or eight leagues in breadth, and ten or twelve in length, stretching from south to north. They are in general composed of a reddish brown sand-stone, running in almost horizontal layers. The mines are numerous, and yield annually seventy thousand pounds weight of mercury. The mineral is either disposed in masses scattered here and there, or in very irregular veins. Liquid bitumen has been noticed in these mines, and likewise bituminous fossil wood.

The mountain of Landsberg, four leagues to the south-west of Creutznach, affords a considerable quantity of mercury. The part which contains the mineral extends five hundred and fifty fathoms in length, and three hundred in breadth. It is nearly three centuries ago since this mine was first opened, and it is said to have yielded annually twenty thousand pounds of mercury. In the mine of Mœrsfeld, near Creutznach, according to Collini, they find petrified mercurial fish spotted all over with cinnabar. The fish are enclosed within black slate, and are extremely thin and brittle.

The principal mine of mercury in *South America* is in the district of Guanca-Velica in Peru. It is near the top of one of the cordilleras, at the immense height of fourteen thousand perpendicular feet, and is immediately surmounted by a summit which rises four hundred fathoms above it. The town of Guanca-Velica, though situated in a bottom, and surrounded by high mountains, is itself near two thousand feet above the lowest plain. This mine, which for two centuries produced annually seven or eight thousand quintals of mercury, is now almost exhausted.

The most striking property in this metal, and that which particularly distinguishes it from all the rest, is its fluidity. This it never loses in the ordinary temperature of our climates; but the natural cold has been sufficiently intense in Siberia to reduce it to a solid and malleable state. Patrin assures us, that during the eight years he resided in

Siberia, he saw it several times in a solid state, particularly in the years 1782 and 1783, which he passed at Tomsk.

As this circumstance is exceedingly interesting, and intimately connected with the natural history of the metal, we shall relate some of the most striking particulars respecting its congelation.

In the winter of 1733, M. Gmelin, with two other gentlemen of the Russian Academy, were sent by the empress Anne Ivanouana, to explore and describe the different parts of her Asiatic dominions. In the winter of 1734-5. M. Gmelin being at Yeneseisk, in 58° 30′ north latitude and 92° longitude east from Greenwich, observed an amazing descent of the mercury in his thermometer, which must have been attended with congelation, as it greatly exceeded the point at which quicksilver becomes solid *. The following remarks by M. Gmelin will give us some idea of the extreme severity of a Siberian winter: " Here we first experienced the truth of what travellers have related with respect to the extreme cold of Siberia; for about the middle of December such severe weather set in, as we were sure had never been known in our time at Petersburg. The air seemed as if it were frozen, with the appearance of a fog, which did not suffer the smoke to ascend as it issued from the chimneys. Birds fell down out of the air as dead, and froze immediately, unless they were

* —40, *i. e.* 40 degrees below zero of Fahrenheit's thermometer.

brought into a warm room. Whenever the door was opened a fog suddenly formed round it. During the day, short as it was, parhelia and haloes round the sun were frequently seen; and in the night mock-moons and haloes about the moon. Finally, our thermometer, not subject to the same deception as the senses, left us no doubt of the excessive cold; for the quicksilver in it was reduced on the fifth of January (old style) to $-120°$ of Fahrenheit's scale, lower than it had ever been observed in nature."

The phænomenon of the natural congelation of quicksilver has since been more particularly noticed by professor Pallas, who, in the year 1772, was sent by the empress of Russia, with some other gentlemen, on an expedition similar to that of M. Gmelin. M. Pallas remarks, that at Krasnoyarsk, on the 6th and 7th of December of the above-mentioned year, there happened the greatest degree of cold he ever experienced in Siberia: the air was calm at the time, and seemingly thickened, so that, though the sky was in other respects clear, the sun appeared as through a fog. He had only one small thermometer left, in which the scale went no lower than $-7°$; and on the sixth, in the morning, he observed that the quicksilver had sunk into the ball, except some short columns which stuck fast in the tube. When the ball of the thermometer, as it hung in the open air, was touched with the finger, the quicksilver rose; and it could be seen that the solid columns stuck and resisted a good while, and were at length pushed upwards with a sort of violence. He also placed upon the gallery, and on the north side of his house, some quicksilver in an open bowl. Within an hour he found the edges and surface of it frozen solid; and some minutes afterwards the whole was condensed by the natural cold into a soft mass very much like tin. While the inner part was still fluid, the frozen surface exhibited a great variety of branched wrinkles; but in general it remained pretty smooth in freezing. The congealed mercury was more flexible than lead; but on being bent short it was found more brittle than tin; and when hammered out thin it seemed somewhat granulated. When the hammer was not perfectly cooled, the quicksilver melted away under it in drops; and the same thing happened when the metal was touched with the finger, by which also the finger was immediately benumbed. When the frozen mass was broken to pieces in the cold, the fragments adhered to each other, and to the bowl in which they lay. In the warm room it thawed on its surface gradually, by drops, like wax on the fire, and did not melt all at once. Although the frost seemed to abate a little towards night, yet the congealed quicksilver remained unaltered, and the experiment with the thermometer could still be repeated. On the seventh of December the professor continued his observations; but some hours after sunset a north-west wind sprung up, which raised the thermometer to — 46°, when the mass of quicksilver began to melt.

These experiments, made by a person of undoubted veracity, would have been sufficient to set aside the notion that fluidity was an essential property of quicksilver, even if that had not been done before by Mr. Braun, professor of philosophy at Petersburg. This gentleman had recourse to art to effect that which Nature had done for Pallas. He availed himself of a good opportunity for the purpose on the 14th of December, 1759, when the mercury in the thermometer stood in the open air at —34°, which is now known to be only five or six degrees above its point of congelation. Assisting this natural cold, therefore, with a mixture composed of aqua-fortis and pounded ice, his thermometer was sunk to —69°. Part of the quicksilver must now have been really congealed, but unexpected by him, and he only thought of pursuing his object of producing still greater degrees of cold; and having expended all his pounded ice, he was obliged to use snow instead of it. With this fresh mixture the mercury sunk to —100, —240, and —350°. On removing the thermometer he found it whole, but the quicksilver was fixed, and continued so for twelve minutes. The experiment was repeated with another thermometer, which was graduated only to 220 degrees below zero, when all the mercury sunk into the ball and became solid as before.

Mr. Braun now suspected that the quicksilver was really frozen, and prepared for making a decisive experiment. This was accomplished on the twenty-fifth of the same month, and the bulb of the thermometer broken as soon as the metal was congealed; when it appeared that the mercury was changed into a solid and shining metallic mass, which flatted and extended under the strokes of a pestle, being rather less hard than lead, and yielding a dull sound like that metal. M. Epinus made similar experiments at the same time, employing as well thermometers as tubes of a larger bore; in which last he remarked that the quicksilver fell sensibly on being frozen, assuming a concave surface, and likewise that the congealed pieces sunk in fluid mercury. In their further experiments they invariably found that the mercury sunk lower when the whole of it was congealed, than if any part of it remained fluid; all tending to prove that mercury, contrary to water, contracts in freezing. It was further observed, that the mercury, when congealed, looked like the most polished silver, and when beaten flat it was easily cut with a penknife, like soft thin sheet-lead.

It is a singular fact, that where Pallas witnessed the spontaneous congelation of mercury the climate is colder than in many countries of Europe eight or ten degrees more to the northward, and this difference is more particularly sensible as you advance to the east. Patrin tells us that the environs of the river Amour, which are in the same latitude as Flanders, are more icy than the banks of the Neva.

Mercury is the heaviest of all metals except gold and platina, and is almost as unalterable as those precious substances. Boerhaave digested quicksilver for fifteen years in a low degree of heat, without its being in the least altered. We are told that the same philosopher had the patience to distill mercury more than five hundred times without any alteration taking place. This metal unites very readily with gold and silver so as to form an amalgam. In Chili and Peru they turn the knowledge of this property to good account, and employ quicksilver to extract the native silver from its ores; after which the mercury is separated by heat in iron retorts, and the silver left in a state of purity.

The amalgam of mercury and silver is susceptible of crystallization, and forms, with the addition of nitrous acid, a very curious apparent vegetation, known by the name of *Arbor Dianæ*. As the result of the process, when properly conducted, affords a pleasing and curious instance of mineral crystallization, we shall describe the shortest way of effecting it. Dissolve four drams of silver and two drams of quicksilver in pure nitrous acid, and when the solution is completed add five ounces of distilled water. This must be put into a spherical vessel of white glass, containing six drams of an amalgam of silver, of the consistence of butter. The vessel must then be put in a perfectly quiet place, not subject to the least agitation, and at the end of some hours the figure of a brush or silver tree will be formed within the water of the glass vessel. The metals contained in the solution and in the amalgam attract each other, and a number of small four-sided crystals are formed, which unite, and exhibit the appearance of a tree.

Mercury combines very easily with sulphur; and when the two substances are rubbed together for any length of time, they form a black preparation called *ethiops mineral:* when this has been repeatedly sublimed it is converted into a deep red-coloured mass, in small needle-form crystals, known by the name of *artificial cinnabar.* This again, when pulverized, becomes the beautiful colour called *vermilion.* There are several other mercurial combinations of equal use in medicine and the arts; but as they, like what we have already mentioned, are all strictly chemical, it would perhaps be stepping too far beyond our limits to describe them.

BASALTIC COLUMNS.

*Designed by W. Daniell.*

*Published by Mess.rs Cadell & Davies London March 1. 1807.*

# BASALTES.

### GENERIC CHARACTER.

Colour a dark iron gray.

Composed of flint, clay, lime, and iron, in different proportions.

Melts with a strong heat into a blackish glass.

### SPECIFIC CHARACTER.

| | |
|---|---|
| Basaltes columnaris. | B. obscurus compactus duriusculus tenax in fragmenta prismatica granulata sponte secedens. *Lynn. Syst. Nat. Gmel.* 3. p. 151.<br>Dark basaltes, compact, harsh, and tough; separating spontaneously into granulated prismatic fragments.<br>Basaltes figura columnari, lateribus inordinatis. *Waller. Syst. Miner.* 1. p. 319. no. 9.<br>Smectis crystallisatus, crystallis oblongis irregularibus. *Carth. Miner.* 21. |
| Basaltes. . . . . | *Cronst. Miner.* 2. p. 913. note. *Kirwan, Miner.* 1. p. 431. *Patrin, Hist. des Miner.* 5. p. 270. *Brongn. Miner.* 1. p. 455. |

This very singular production is found in several parts of Europe, but no where in such abundance as in Scotland and Ireland. The stone is generally of a blackish-gray colour, difficult to break, and sounding under the hammer like brass. It is of a prismatic shape, and generally hexangular, but by no means constant in this respect, as basaltic pillars are found with three, four, five, six, and seven sides. Immense numbers of these pillars are sometimes collected together and joined side by side, either in a vertical or an inclined direction. They vary considerably both in size and height, being found from a few inches to three or four feet in diameter, and from five to fifty or sixty feet high. Sir J. Banks remarked, when he visited the island of Staffa, that the surfaces of the large pillars were in general rough, uneven, and full of cracks in all directions, some of which were filled with a yellow spar. He likewise noticed that the surfaces of the larger number were concave, though some were evidently convex.

When a large mass of basaltes is found to extend to a considerable distance with a tolerably uniform surface, it is called a causeway. In France there are several basaltic causeways, particularly in Auvergne, in Velay, and Vivarais ; but none of these are to compare with the Giant's Causeway on the northern coast of Ireland. This wonderful assemblage of basaltic columns has been frequently described by travellers ; but the most recent account is that by M. Pictet, who was in Ireland in the year 1801. This gentleman describes it as a sort of promontory, or rather pier, gradually descending

GIANTS CAUSEWAY.

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towards the sea, and terminating in a point, over which the breakers dash with violence. This pier composes the western horn of a bay in the form of a crescent, surrounded by high and rugged ground, which exhibits some fine basaltic phænomena. On all sides are to be seen groups of columns, to which the guides have given different names, according to their supposed resemblance to some familiar object; thus they call one mass of columns at the bottom of the bay the organ, another the weaver's loom, &c.

The mass of columns which run into the sea and form the causeway itself, are nearly on a level with the beach, and, being composed of vertical pillars with horizontal surfaces, exhibit at a distance the appearance of a stone pavement. But on approaching the shore, we perceive that the sections of the columns are so far from being upon the same level, that in traversing the causeway we are continually obliged to go up and down. All the prisms which compose this natural pier are almost in perfect contact with each other, without any intermediate substance between them; in which respect they differ from the basaltes at Dunbar, where the intervals between the columns are said to be filled with a coarse kind of jasper.

The columns of this famous causeway are nearly of the same size; and their mean diameter, says M. Pictet, is from twelve to fifteen inches. They differ in the number of their sides, some having four, and some eight; but those with six sides are by far the most numerous. It has been noticed by every one who has examined basaltic columns, that they are for the most part formed of a number of pieces, nearly equal in size, which rest one upon the other, and which are immediately detected by the line of separation. On removing any of these pieces from the main column, they are almost always found with one face convex and the other concave.

The basaltes of which the causeway is composed is of a blackish colour, and hard enough to strike fire, imperfectly, with steel. It is of a close texture, and disturbs the magnetic needle.

When any cavities are perceived in the basaltic pillars, it is more generally towards the top than elsewhere. Indeed it has been said, that the upper joint of each pillar, where it can be ascertained with any certainty, is always rudely formed and cellular. The gross pillars also in the capes and mountains frequently abound in holes through all their parts, which sometimes contain fine clay, and other apparently foreign bodies; and the irregular basaltes, beginning where the pillars cease, or lying over them, is in general extremely honey-combed, containing in its cells crystals of zeolite, little morsels of fine brown clay, sometimes very pure steatite, and in a few instances bits of agate.

From the iron ore found intermixed with the basaltes, and the vast beds of red ochre which separate the ranges of columns at different heights, M. Pictet very reasonably supposes that iron in the state of an oxide must abound in those regions. To the eastward of the bay there are said to be beds of this ochre, of prismatic basaltes in regular colonnades, and of other basaltes which are jumbled together in a very confused manner, and mixed with earth. These alternate beds of basaltes and ochre are several times repeated, but the ochre particularly occupies the lower part of this enormous heap, of which the height has been estimated at about three hundred and fifty feet.

" The time stole on," says M. Pictet, " and our benevolent and active conductor had still other things to show us, more to the eastward; but as it is bad travelling on the beach, especially when the sea is rough, we returned along the same path by which we had descended, and for two miles followed all the windings of this steep coast; from time to time cautiously approaching the edge of the declivity, to enjoy the prospect of the inaccessible bay below, where the sea may be seen rolling in and breaking furiously upon the black rocks which collect upon their banks. These bays are entirely covered by columnar basaltes arranged in floors, piled upon each other, till they almost reached us.

" Continuing to follow this remarkable coast, we arrived at the end of a promontory, whose greatest height is towards the sea, where it resembles the point of a gigantic bastion, rising almost vertically to the height of three hundred and twenty-two feet above the shore: it is called *pleskin*. Here I want expressions to paint to you the scene, at once sublime and terrific, which presented itself to us as soon as we dared to look at it. The Giant's Causeway, which but lately had engaged our attention, was no more than a child's plaything, a mere miniature, compared with the abyss which our eyes now contemplated with an almost insatiable curiosity. This advanced post permitted us to enjoy the whole of that at once which till then we could only catch by fragments. Here a person may study, at his ease, the magic superposition of these immense colonnades; admire the regularity of their shafts, from thirty to forty feet, of which many are composed; and attempt to fathom the causes which in some period of this globe's existence have contributed to produce such wonderful effects."

The finest specimen, however, of columnar basaltes is the island of Staffa, in the Hebrides, which had scarcely been noticed till Sir Joseph Banks paid it a visit in a journey to the North of Scotland. Mr. Pennant, in his Voyage to the Hebrides, in the year 1772, mentions it as a new Giant's Causeway rising amidst the waves, but with columns of double the height of that in Ireland, "glossy and resplendent from the beams of the eastern sun." What little this gentleman saw of the island, he caught while pursuing his voyage, and observes that the greatest height of the columns was at the southern point of the isle, of which they seemed the support; and that they decreased in height in proportion as the vessel advanced along that face of

Staffa which was then opposed to them, or the eastern side.

The island of Staffa lies on the west coast of Mull, and is about a mile long and half a mile broad. We learn from the description which Sir Joseph Banks has given of this island, that there is a small bay on the west side, where boats generally land; a little to the southward of which the first appearance of pillars is to be observed. These are small, and, instead of being placed upright, lie down on their sides, each forming a segment of a circle. Above a small cave in the neighbourhood of these pillars, others are found, of larger dimensions and inclined in all directions, particularly a small mass, which very much resembles the ribs of a ship. "From hence," says Sir Joseph, "having passed the cave, which, if it is not low water, you must do in a boat, you come to the first ranges of pillars, which are still not above half as large as those a little beyond. Over against this place is a small island, called in Erse, *Boo-sha-la*, separated from the main by a channel not many fathoms wide: this whole island is composed of pillars without any stratum above them; they are still small, but by much the neatest formed of any about the place."

The sea at high water separates this island into two parts, one of which makes a sort of cone, the pillars converging towards the centre; while on the other, the basaltes in general lie down flat, and in the front towards the sea are beautifully packed together, their ends coming out square so as to form a bank. The main island opposite to Boo-sha-la, and more to the north-west, is supported by ranges of pillars tolerably erect and of large diameters. At their feet is an irregular pavement, made by the upper sides of such as have been broken off, which extends as far under water as the eye can reach.

After proceeding along shore to the north-west, and passing Fingal's Cave, which we shall presently describe, Sir Joseph met with the highest ranges of pillars, which, he tells us, are magnificent beyond all description: they are bare to their very bases, and the stratum below them is also visible, which has very much the appearance of a lava. Beyond this place, round the north end of the island, is situated the *Corvorant's Cave*, where the pillars, though considerably less than the last-mentioned, are still of a large size. After these a few others occur, but of no consideration: at length, as you proceed, they totally cease, nor do you meet with any signs of regular basaltic formation again till you have nearly completed the tour of the island, and have once more arrived at the bending pillars.

The greatest curiosity in Staffa, is, unquestionably, the *Cave of Fingal*, which Sir Joseph Banks has described as follows: "We proceeded along the shore, treading upon another Giant's Causeway, every stone being formed into a certain number of sides and angles, till in a short time we arrived at the mouth of a cave, the most magnificent, I suppose, that has ever been described by

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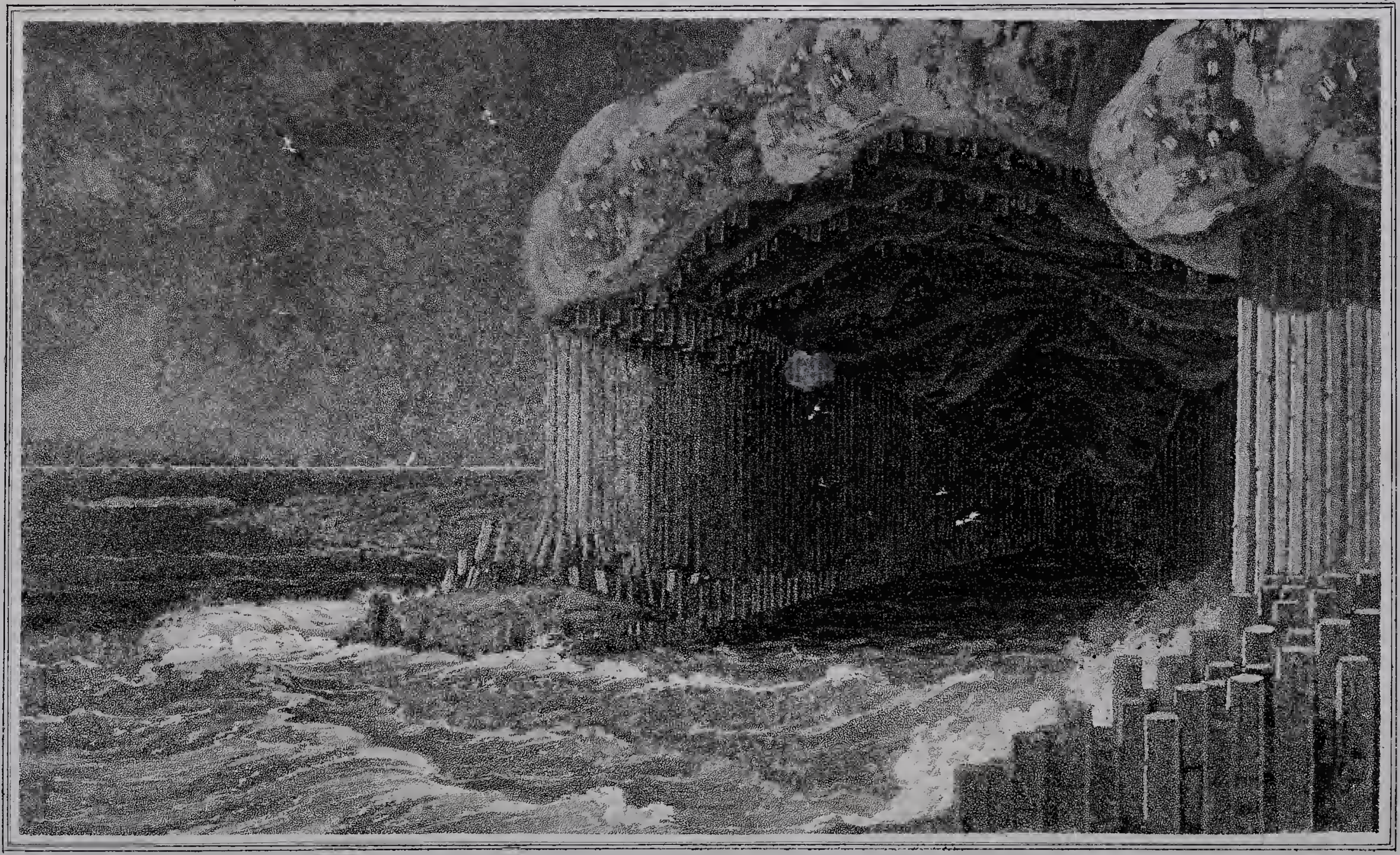

CAVE OF FINGAL.

*Designed by W. Daniell.*

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travellers. The mind can hardly form an idea more magnificent than such a space, supported on each side by ranges of columns, and roofed by the bottoms of those which have been broken off in order to form it; between the angles of which a yellow stalagmitic matter has exuded, which serves to define the angles precisely, and at the same time vary the colour with a great deal of elegance: and to render it still more agreeable, the whole is lighted from without; so that the furthest extremity is very plainly seen from without; and the air within, being agitated by the flux and reflux of the tides, is perfectly dry and wholesome, free entirely from the damp vapours with which natural caverns in general abound.

| | Ft. | In. |
|---|---|---|
| " Length of the cave from the rock without | 371 | 6 |
| From the pitch of the arch . . | 250 | 0 |
| Breadth of ditto at the mouth . . | 53 | 7 |
| At the further end . . . | 20 | 0 |
| Height of the arch at the mouth . | 117 | 6 |
| At the end . . . . . | 70 | 0 |
| Height of an outside pillar . . | 39 | 6 |
| Of one at the N. W. corner . . | 54 | 0 |
| Depth of water at the mouth . . | 18 | 0 |
| At the bottom . . . . . | 9 | 0 |

The cave runs into the rock in the direction of N.E.-by-E. by the compass."

Faujas, in his description of this astonishing natural curiosity, says, that the sea is in a constant state of agitation within it, and breaks with fury against the sides and bottom of the cavern. This, however, can happen only when the wind is in the right direction, as there may be often a heavy sea near the mouth, and a comparative calm at the end of the cave. Faujas acknowledges, in another place, that when M. Troil visited this cavern, the sea, "*par un de ces cas extraordinaires qui n'arrivent pas tous les dix ans*," was so calm that it permitted him to enter in a boat. This gentleman observed, that along the bottom of the cave, just below the surface of the water, there is a kind of recess, from whence a very agreeable sound proceeds whenever it absorbs the wave.

Thus far we have confined ourselves to the basaltic phænomena of the British islands; but it is time to notice some of the most curious that occur in other parts of Europe; none of which, however, can compare in point of magnificence with those we have just described. The principal among them are the rocks of the Cyclops in the neighbourhood of Etna, which exhibit some very fine basaltic pillars. These rocks are described and figured by Houel in his *Voyage Pittoresque*, &c. He notices one of the rocks in particular, as producing the straightest and most regular columns of any; and says that at first sight they resemble the majority of those which are met with in France and the British islands, by the regular appearance of their prismatic columns; but on a nearer inspection, we find a remarkable difference; these being assembled in groups of five or six about one, which serves as their common centre. One half of this rock is composed of perpendicular columns; the other of another species of basaltes, disposed in inclined, and almost rectilinear, layers. These are in contact with the columns, and are as closely connected with them as they are with each other: it must likewise be remarked, that the layers are longer at the base than towards the top of the rock, and that they subdivide in general as they rise upwards; so that towards the upper extremities a layer will often exhibit one, two, and sometimes three divisions. These layers, though inclined towards the base, become almost perpendicular near the top of the rock, where they seem united in a point, and over-top most of the visible and elevated parts of the prismatic columns.

The columns terminate in such a manner as to form a kind of staircase. The extraneous matter with which these columns are covered, and of which the summit of this pyramid consists, appears to be of the same species with that which composes the upper part of the island. The basaltes in this place are noticed to be full of small crystals of about the size of peas, which appear as beautiful as rock crystal, but are much softer, and yield to the action of the air. Many fragments of the decayed pillars which formerly contained crystals, are now so full of holes as to resemble a sponge.

Basalt is occasionally found in a flat or round form, as well as in that of a column. Brongniart informs us, that there is a chain of mountains which separate Bohemia from the electorate of Saxony, called the metallic chain, on account of the vast quantity of metal which it contains within its bowels. Basaltes are found on the most elevated points of these mountains, either of a conical or flat shape; and these basaltic summits are almost always insulated. The highest point of this chain is said to be twelve hundred yards above the level of the sea.

Mount Meisner, in Hesse, is crowned with a basaltic platform of one hundred yards in thickness. The body of the mountain is composed of chalk and red sandstone; above the sandstone there is a bed of bituminous matter, divided in places into little prismatic bars. It is on this bed, and on the bituminous argil which covers it, that the basaltic platform rests which composes the summit of the mountain.

The banks of the Rhine, between Bonn and Andernach, and particularly the environs of Unkel, exhibit masses of very fine basaltic prisms, which are of a very compact texture, and enclose large pieces of chrysolite. Basaltic prisms occur at the foot of Vesuvius in Italy, and of Etna in Sicily; with this difference, however, that they are rare about the first mountain, and abundant round the last, where they form a rock, says Brongniart, surrounding the volcanic mountain, which appears to rise from the middle of their mass. This disposition of basaltes is said to be equally apparent in the Appennines, and in several of the islands of the Archipelago.

Among the fine specimens of basaltic columns, those of Auvergne in France, and a part of those of the Cevennes, ought not to be omitted, as they exhibit specimens almost equal to what we find upon the Irish coast. This substance is likewise found in the island of Teneriffe, in that of Goree, in the isle of Bourbon, and in other volcanic isles of the Indian and South seas. Besides those we have mentioned, it is found in many other places, but not in sufficient quantity to deserve our notice. It may be proper to observe, however, that the antique basalt, or that of which the Egyptians made their statues, was brought from the mountains of Ethiopia.

The presence of basaltes in most of the countries where volcanos are found, their black colour, the round cavities which they occasionally present, and the different mineral substances which sometimes insinuate themselves, tend to prove that these stones owe their origin to volcanic fire. But, on the contrary, the striking analogy which exists between certain basaltes and those stones that are evidently of aquatic origin; an analogy founded on their chemical analysis, and strengthened by other circumstances, makes the former hypothesis somewhat doubtful, and has induced many mineralogists to affirm that all basaltes were originally formed by water, or at least in the same liquid as porphyry, &c.

Each of these opinions has been supported by its respective advocates, who have discussed the subject at some length. As this point, however, still remains unsettled, we shall not enter into the particulars on either side, but conclude our account by noticing some of the uses to which basalt has been applied.

In some towns they use the basaltes to pave their streets; but it is observed, that unless they are frequently watered, the stones are apt to break. In Saxony they use this stone to arm the end of their stamping machines with which they pulverize the quartz. As it melts in a strong fire into a black glass, it has sometimes been used to make bottles, and the earth which results from the decomposition of basaltes is said to be very fertile.

The antients, and particularly the Egyptians, employed basaltes in the formation of their monuments and their statues, notwithstanding the difficulty which they must have encountered in shaping so hard a stone. Pliny cites, as a remarkable example, the statue of Nilus with sixteen children playing about it, denoting as many cubits of the rise of the river; and also mentions the statue of Memnon, in the temple of Serapis at Thebes (which uttered a melodious sound every day at sun-rise) as being of the same substance.

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## ERRATA.

### Vol. I.

Page 61, line 16, for northern *read* southern.
113, — 2, — his trunk *read* its trunk.
128, — 28, — Mr. Luke *read* Mr. Leeke.

### Vol. II.

514, line 18, after which, add species.

### Vol. III.

248, line 24, for loeracea *read* oleracea.
370, — 11, — granit *read* granite.
373, — 15, — Ekaterinbug, *read* Ekaterinburg.
467, — 24, — fleue *read* flue.
Wherever Brogniart occurs *read* Brongniart.

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